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THE PARIS-BERLIN MOTOR CARRIAGE RACE—THE WINNER, FOURNIER, AND HIS CHAUFFEUR.

PARIS-BERLIN MOTOR CARRIAGE RACE.

THE Paris-Berlin motor carriage race, from the point of view of its great distance, was the most important ever run, although the speeds were hardly as great as in the Paris-Bordeaux race. There are, however, many reasons why a greater speed was not obtained. In the first place, the distance was much greater; secondly, the roads were not as good, and, finally, great precautions had to be taken in running through the cities and towns, which served to materially reduce the running time. All of the towns and many of the villages on the route of the journey were "neutralized," each carriage being piloted by cyclist marshals at slow speed until the outer limit was reached. The competition was divided into three classes: Class A, for touring carriages whose owners wished to show the merits of the various systems; Class B, for touring carriages whose owners did not desire any restrictions, and Class C, for racing cars. The first two classes started five days earlier than the racing cars, and the distance was covered in eight laps which varied from 79 to 128 miles in length. The route was via Rheims, Luxembourg, Coblentz, Frankfort, Eisenach, Leipsic, Potsdam, to Berlin. Little attention was paid to their doings, although the Kaiser caused to be erected for their benefit a military bridge across the Moselle at Treves—the first indication of the amity which was subsequently so abundantly displayed.

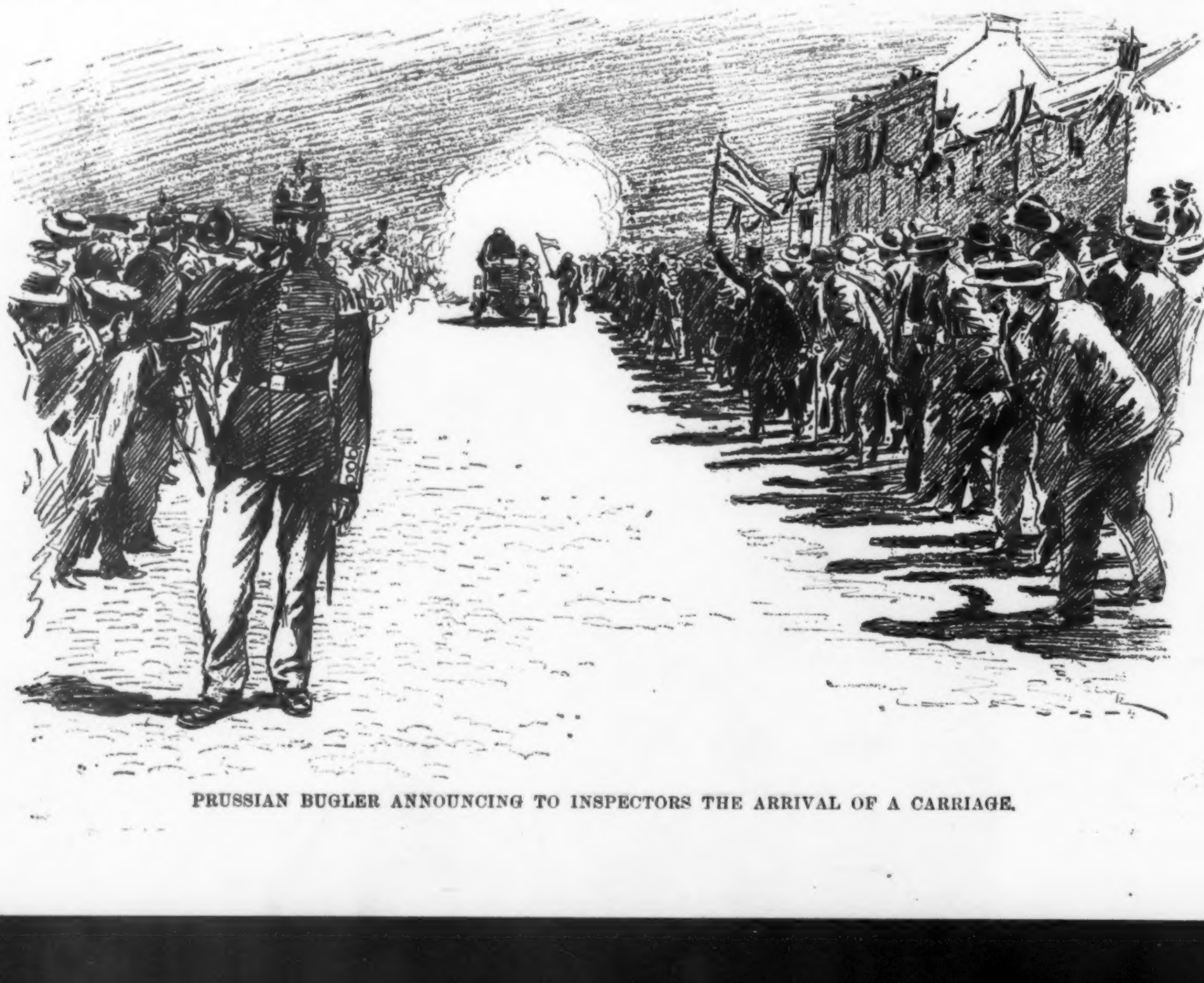
AN ARRIVAL AT AIX-LA-CHAPELLE.

It was the speed brigade, however, which aroused the liveliest interest on the route. The racing class took an entirely different route, starting on Thursday, June 27, instead of the preceding Saturday. The distance was divided into three sections: Paris to Aix-la-Chapelle, 282 miles; Aix-la-Chapelle to Hanover, 276 miles; Hanover to Berlin, 184 miles. For a fortnight before the race the vague odor of petroleum was hanging about the streets and boulevards and day and night were made hideous by the exhaust of the autocars and the tooting of trumpets. The Auto-Velo, the daily journal devoted to the interests of the sport, came out as an eight-page paper and published a special edition in the evening giving the results of each day's race. Nothing in the sporting world has created such interest in years as this race, although the automobile has never been popular with a large mass of the inhabitants of Paris, and they are simply detested by the peasants. These wild races from one end of France to the other are beginning to wear upon their nerves.

One hundred and seventy vehicles entered for the race, and their motors were of all sizes up to 70 horse power. Out of the 170 machines entered, 110 started from Champigny, near Paris. Among them were forty large racing cars, forty-eight light carriages and ten motorcycles. Forty of the racing cars made the trip successfully from the banks of the Marne to the banks of the Spree, including eleven light carriages, four voiturettes and four motorcycles. At the starting place, and for miles up and down the road, enormous throngs were gathered. Several hundred motor carriages which were not entered for the race carried their occupants to see the start, and the gay parties breakfasted by lantern light. The racing vehicles stretched half a mile along the road. The photographers were kept busy making negatives by limelight. Finally, the machine of Fournier started amid the cheers of the crowd. The same stirring scene was repeated every two minutes until 7 o'clock in the morning, when the last of the horseless vehicles had started. The crowd was particularly enthusiastic when Mme. Du Gast, the only woman racing, wearing a gray leather costume and a heavy dust veil, wound up the procession.

A triumphal arch had been erected at Aix-la-Chapelle, and a great crowd had gathered by noon. The first to arrive was M. Fournier, the winner of the Paris-Bordeaux race, driving a 50 horse power Mors car. Eleven Panhard cars came in next, bringing well-known automobilists, including M. René de Knyff and M. Charron. M. Fournier's time was 8 hours, 28 minutes, 23 seconds. There were many accidents in the first day's race. At Rheims a child ran out before the carriage of M. Brasier and was instantly killed; it was not, however, the fault of the chauffeur. Mr. Edge, an English racer, in his 60 horse power Napier car, ran into a tree and had a narrow escape. He was able, however, to repair the damage and resume his journey. The day was marked by several other accidents. In one of them, Mr. Foxhall Keene, the only American competitor, met with an accident. His carriage was overturned in a potato field, but he was not injured.

The start was made for Hanover at 5 o'clock the next morning, this being the second stage of the journey. About 80 carriages took part, starting in the same order in which they arrived at Aix-la-Chapelle, M. Fournier, who arrived first, practically leading the way all the distance, but at one town M. Girardot cut in front and the cars collided. No harm was done to the vehicles, although a boy was injured. The turning post at Hanover was fixed in a corn field, five miles outside the town. At 2.13 M. Fournier arrived in clouds of dust, covering the 276 miles in 9 hours, 7 minutes and 39 seconds, his tires being punctured twice during the



PRUSSIAN BUGLER ANNOUNCING TO INSPECTORS THE ARRIVAL OF A CARRIAGE.

journey. M. René de Knyff came in at 2.35. On the return trip there was also a train of mishaps and breakdowns. One of the carriages blew up, hurling its occupants into the roadway, though happily no one was seriously hurt. The two days' accidents caused the French papers to devote much space to the great neces-

A MUCH-NEEDED TOILET ON ARRIVAL AT HANOVER.

sity for legislation to prevent such dangerous sports as automobile racing, and many journals denounced it vigorously as infringement on public liberty and the safety of human life.

The correspondents who saw M. Fournier start from Hanover at 5.15 the next morning took a special train for Berlin, and when it arrived they found the country roofs lined with people. The West End race course, the winning point, presented a brilliant scene. Sol-

diers and many officers in bright uniforms gathered there to witness the finish. The enthusiasm was almost uncontrollable when at 11.46 A. M. Fournier arrived with his Mors car and rushed past the post ten seconds later. His numerous friends broke through the line of troops, surrounded the car, cheering him loudly. The band struck up the "Marseillaise" and the Germans carried him on their shoulders to the judges' stand and thence to the prize platform, which, like the winning post, was decorated with the French and German flags. The victor did not seem the least fatigued, which was more than most of his competitors could say. He was attired in brown oilskins and wore a mask, while his eyes were protected by spectacles.

Although M. Fournier had eleven punctures, his average speed was 46 miles an hour. By allowing time for repairing the punctures, this would make the average time about the same. The excitement in Paris centered around the Automobile Club and a big blackboard in the lobby gave the crowd information as to the successful stages of the long journey.

The following is the elapsed time of all of those who finished the course:

I.—RACING MACHINES.

1. Fournier, in 17h. 3m. 43s.
2. Girardot, in 18h. 9m. 58s.
3. R. de Knyff, in 18h. 12m. 57s.
4. Brazier, in 18h. 46m. 6s.
5. H. Farman, in 19h. 24m. 21s.
6. Charron, in 19h. 57m. 48s.
7. André Axt, in 20h. 2m. 52s.
8. P. Chauchard, in 20h. 31m. 55s.
9. Heath, in 20h. 35m. 4s.
10. Jarrott, in 20h. 35m. 21s.
11. Gilles Hourgières, in 20h. 41m. 7s.
12. Voigt, in 21h. 43m. 6s.
13. G. Leys, in 22h. 21m. 5s.
14. Van der Heyden, in 22h. 53m. 31s.
15. Werner, in 23h. 49m.
16. Alb. Lemaître, in 23h. 11m. 16s.
17. Clément, in 23h. 25m. 13s.
18. Ch. Rolls, in 24h. 49m. 7s.
19. Mme du Gast, in 27h. 3m. 11s.
20. Brillie, in 30h. 13m. 40s.
21. J. de Crawhez, in 30h. 32m. 19s.

II.—LIGHT CARRIAGES.

1. E. Giraud, in 20h. 54m. 52s.
2. Sincholle, in 23h. 32m. 53s.
3. Teste, in 23h. 33m. 45s.
4. G. Berteaux, in 23h. 38m. 33s.
5. Edmond, in 24m. 8m. 39s.
6. Kraeutler, in 26h. 6m. 58s.
7. A. Roland, in 26h. 14m. 59s.
8. Gondoin, in 26h. 42m. 43s.
9. Mercy, in 27h. 5m. 11s.
10. Dernier, in 28h. 39m. 45s.
11. Haban, in 31h. 48m. 41s.

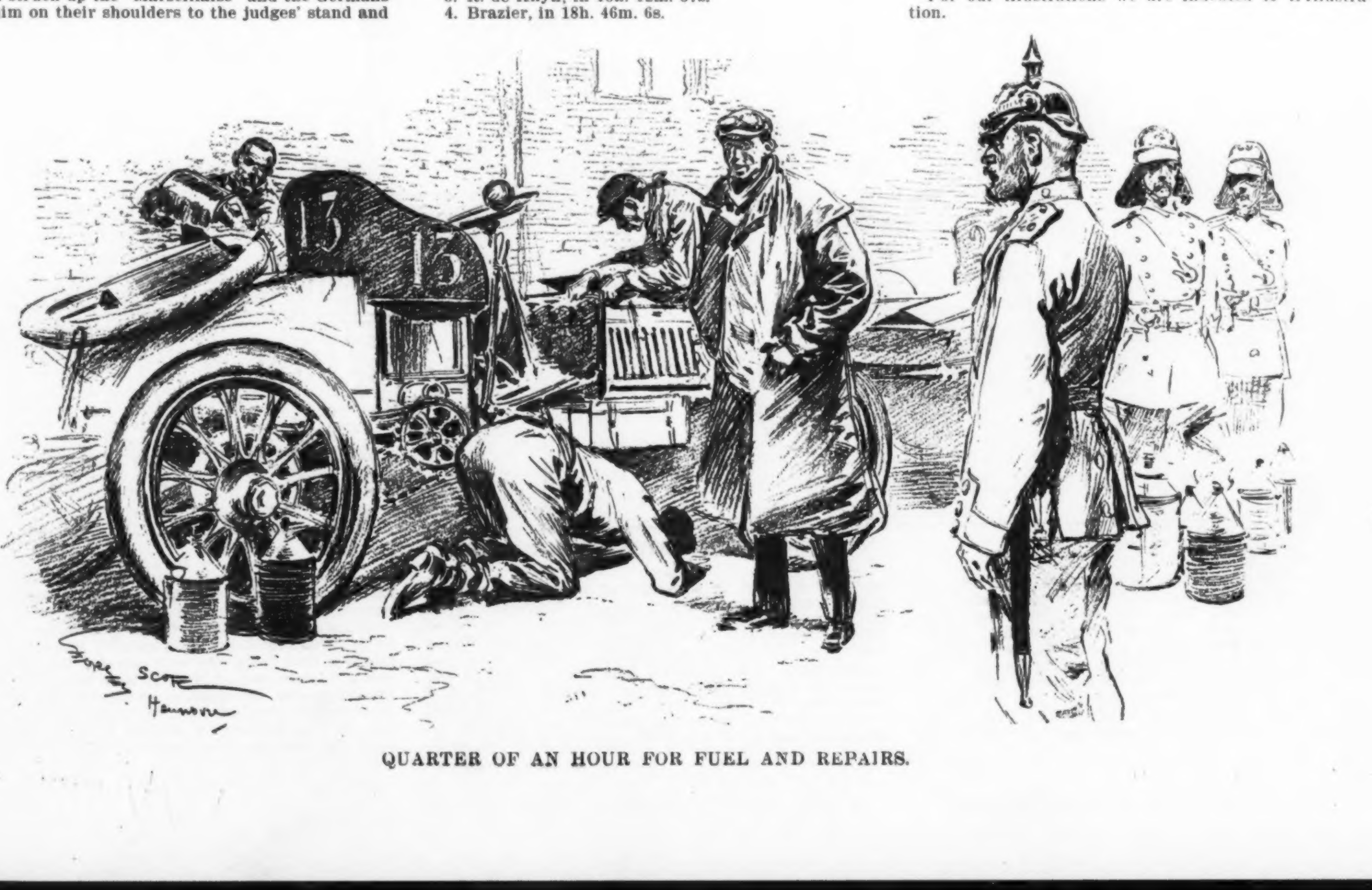
III.—VOITURETTES.

1. Louis Renault, in 20h. 33m. 56s.
2. Grus, in 24h. 2m. 15s.
3. Oury, in 27h. 45m. 15s.
4. L. Morin, in 30h. 52m. 1s.

IV.—MOTOR CYCLES.

1. Osmont, in 20h. 18m. 48s.
2. Bardeau, in 22h. 5m. 58s.
3. Cormier, in 23h. 29m. 57s.
4. Bardin, in 23h. 39m. 4s.

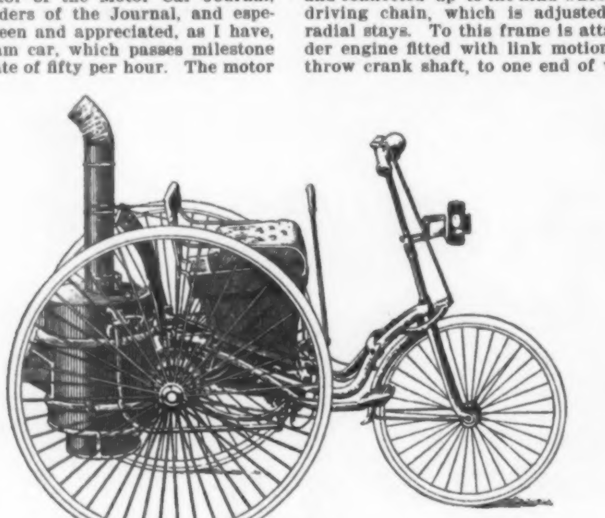
For our illustrations we are indebted to L'Illustration.



QUARTER OF AN HOUR FOR FUEL AND REPAIRS.

THE ORIGINAL SERPOLLET STEAM CAR.

The following history of the first steam tricycle, taken from the account of the lecture given by M. Léon Serpollet in Brussels last month, is so amusing that I feel sure, says the editor of the Motor Car Journal, it will interest the readers of the Journal, and especially those who have seen and appreciated, as I have, the latest Serpollet steam car, which passes milestone after milestone at the rate of fifty per hour. The motor of the tricycle had one cylinder and a boiler like a coke stove, with a chimney out of which steam and sometimes thick smoke escaped. M. Serpollet applied for a license to drive it, and started off to pass his examination as a chauffeur. The road was rough and badly paved with uneven sets, and the tricycle bumped and bounded along until it suddenly came to a dead stop—a breakdown. The cause was not difficult to locate; the bumping had loosened the fire bars, which one by one had dropped out, carrying the fire with them, and leaving the road behind strewed with the smouldering remains. Nothing daunted, M. Serpollet picked up the bars, fixed them in again, relit the fire with the aid of a neighboring coal merchant, and set off again, arriving only an hour behind time. He got his permit, and deserved it.



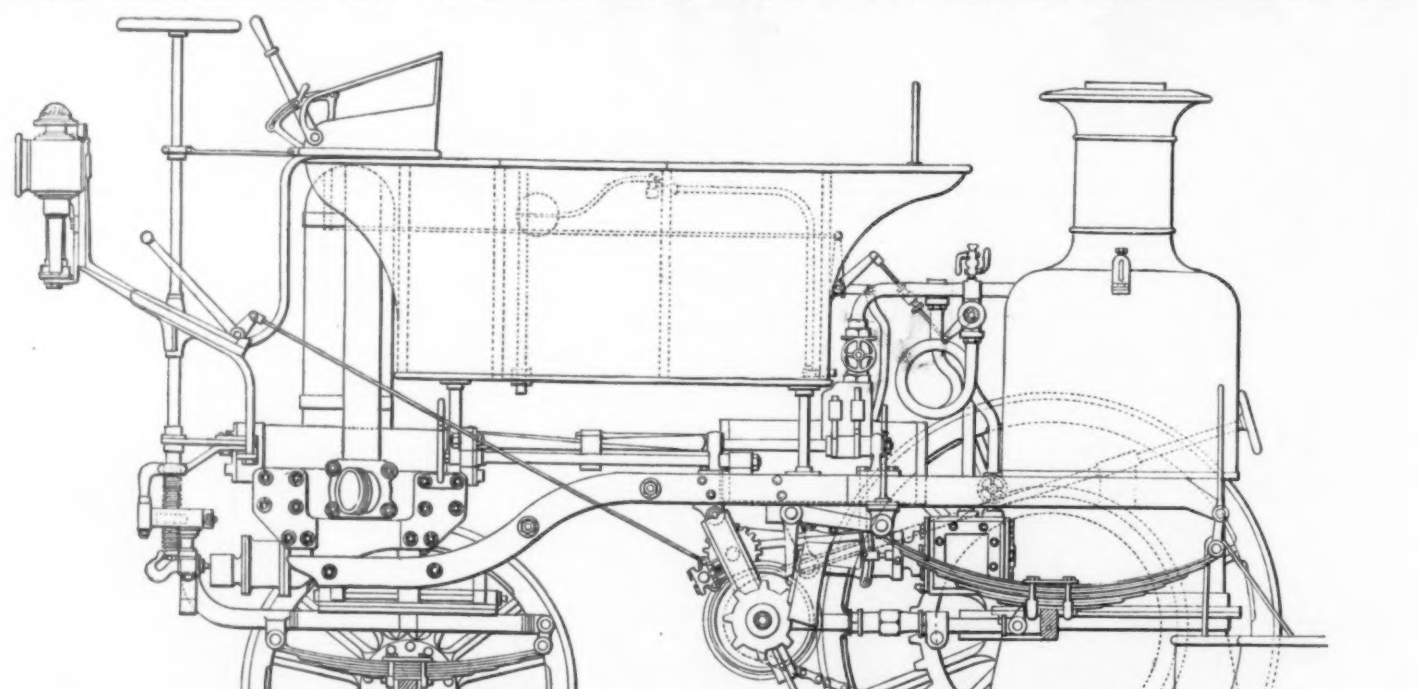
THE ORIGINAL SERPOLLET STEAM CAR.

MOTOR STEAM FIRE ENGINE.

The steam fire engine belonging to the Norwich Union Fire Insurance Company, and stationed at Worcester, has been recently converted from a horse-drawn engine into a self-propeller by Mr. Chas. T. Crowden, of Leamington. The conversion was effected while the engine was kept in service, and it attended several fires while the work was in progress. The original road wheels were far too light for motor purpose, and a new set of wheels was constructed under Mr. Crowden's patents, by which the spokes are set back at the hub, thereby insuring safety against the great lateral strains to which motor wheels are subjected. The hind or driving wheels are fitted with star wheels and sprockets. A motion frame for carrying the crank shaft, differential shaft and gearing was hung to the main frame in front of the brake shaft by two special brackets and fixed by two bolts, these bolt holes being practically the only fresh holes made in the existing frame. The motion frame is attached to and can be removed from these brackets when required. Each end of the differential shaft is fitted with a sprocket pinion and connected up to the hind wheels by means of a pitch driving chain, which is adjusted by two setting up radial stays. To this frame is attached a double cylinder engine fitted with link motion, driving the double throw crank shaft, to one end of which is fitted a pinion driving the differential gear shaft to the ratio of 5.1 to 1. Steam is taken to the propelling engine from the main steam pipe feeding the fire engine, and the exhaust is taken into the existing fire engine exhaust pipe; these pipes were made in such a form as to allow for a certain amount of spring when adjustments were made to the chains as the engine and motion frame move forward. The old hose-box was removed and a water tank substituted having a seat and footboard for three men to sit abreast, and a fireman sitting on the top of the water tank with footboards as before. The center man or driver has full control and manipulation of the engine from his seat. An extra screw brake is provided as an emergency brake; it can be operated from behind by the stoker, the coal bunkers have been altered to give a larger capacity, and a seat is fitted for the stoker for firing en route. The boiler is provided with a detachable ashpan for preventing the hot cinders falling upon the road. The original forecarriage is used, a channel steel sector being fitted to the splinter bar by two stanchions, and a chain pinion attached to the vertical shaft gearing into a length of pitch chain fixed in the channel to serve the purpose of a rack. Should the motor part of the engine become disabled the motor engine and gearing can be easily removed by withdrawing a few bolts, and the engine used as a horse-drawn engine. The boiler, when the motor engines were used, was originally fed by an injector which was not altogether satisfactory, and a feed pump is now being attached, worked from the countershaft; also a special apparatus for filling the water tank from the river or roadside streams and other sources. The motor engine has proved itself very satisfactory up to the present, and will run on the level road at a speed of about 12 miles an hour, and will climb all the hills that have been met with up to the present, some grades of which in this district are very severe. It is stated that a very great saving will be effected by its use in Worcester, the horsing of the engine previously costing a guinea a mile, and the work being so severe that no one cared about lending their horses for the fire engine, which weighed about three tons when loaded with all its appliances and firemen. Often thirty to fifty minutes have been wasted in getting horses, which, when an alarm of fire was given, were at work at their daily duties. A considerable amount of time was also lost in finding the proper harness for them; the horsing of steam fire engines in country districts is a very difficult question. The motor after lighting the fire can be got away in about five minutes under its own steam. The speed of the motor is about twelve to fourteen miles an hour.

For our engraving and the foregoing particulars we are indebted to The Engineer.

One of the first experiences with the motor steam fire engine, which we have just described, was rather unfortunate. One evening the brigade received a call to a fire about three miles from the city, and they turned out with their motor fire engine. Before they reached the city boundary, the sparks from the engine had ignited a load of straw standing in the roadway, and the hedges caught fire in two places. The city fire brigade were called out to extinguish the blazing straw, but the whole was consumed and the wagon damaged. Other hedge fires started, and two straw ricks were ignited by the engine before it reached its destination, while on arriving there a pipe in the engine burst and rendered it useless.



SELF-PROPELLING STEAM FIRE ENGINE.

THE MECHANICAL FORCES OF NATURE AND THEIR EXPLOITATION.

The question of the probable end of the world's coal supply, in the not far distant future, is one which has in recent years been the cause of much discussion. In connection with this subject, a pamphlet published by the Urania Gesellschaft of Berlin, on "Die Mechanischen Naturkräfte und deren Verwertung," by F. Reuleaux, is of interest. In a clear and popular manner the author traces and explains the gradual utilization by mankind of the various natural forces, from the ancient Assyrian water wheel to the installations of Niagara, and the Parsons steam turbine. It has been calculated that the supply of coal in England can only last at the most 200 years more; and though the coal fields of the other European countries have not been used to the extent that the English ones have, still their eventual exhaustion can already be anticipated. The total consumption is now about 600,000,000 tons per year, or, measured as a volume, about 500,000,000 cubic yards. Assuming a yearly increase of 5 per cent (it is at the present moment greater than this), this would mean that during the present century 6,500,000,000 cubic yards of coal will be taken from the earth's coal mines. A cube of this volume would have a side over ten miles long.

It may be urged that this is not a matter of immediate importance; still, in considering the future industrial state of the world one must admit that great changes must take place, and that countries which have been indebted for their growth to their natural resources of power in the form of coal must give way to those countries where power is supplied in another form. On examining the natural sources of power, one sees that really the only other available source of power besides coal, which, it may be said, can be regarded as the accumulated energy of the sun, stored up through countless ages, is water power. This, unlike coal, is a source of energy which is always with us. The sun piles the water of the ocean upon the

mountain side, and following the force of gravity it flows down again in a never ending cycle, watering, fertilizing and, under the careful direction of mankind, rendering the land fruitful and inhabitable and providing for the wants of the human race a source of power immeasurably greater than any power to be derived from the combustion of coal, and what is more, a source of power which will never cease, or be exhausted, while the world lasts. To form a computation of the total energy of the atmospheric depositions is very difficult. It has been calculated to reach the value of 100,000,000 horse power. The realization of the one-thousandth part of this would be enough to replace the whole of the coal consumption for an incalculable time to come.

An example of how a water power can be used to its fullest extent is furnished by the Upper Hartz. There nearly every drop of water available is utilized, and, although boasting no streams of any size, the respectable total of 3,300 horse power is generated and used in the mining operations carried on there. It is, however, with the advent of electricity that the full realization of water power has become possible. By means of the facilities offered by this agent we arrive back at the original motive power of mankind, and will be enabled to tap energies incalculable in comparison with our present ones. This greatest and farthest-reaching application of electricity is but now in its infancy. In 1891, only ten years ago, the first long-distance power transmission plant was erected at Lauffen, on the Neckar. The power, amounting to 100 horse power, was transmitted to the electro-technical exhibition at Frankfort on the Main, a distance of 110 miles, at a voltage of 8,000 volts, using a three-phase current. In the short space of time since then immense progress has been made. Now whole towns and large tracts of country are supplied with power and light from distant waterfalls, and new industries have sprung into existence which were formerly impossible. The future developments of this branch of science will be as great, comparatively, as the mighty forces of nature they are designed to employ, and in endeavoring to imagine them the scientific mind merges into the poetic, with which it is, after all, very closely related.—Nature.

THE "LANCASTER" MARINE SPECIALTIES AT THE GLASGOW EXHIBITION.

The aim of Messrs. Lancaster & Tonge, Ltd., Engineers, Pendleton, Manchester, has been to present as comprehensive an exhibit of their specialties as possible. They show five sizes of the Lancaster steam traps, ranging from ½ inch to 2 inches inlet, and suitable for pressures of from 5 to 300 pounds per square inch. Five types of Lancaster pistons, also piston rings and springs ranging from 112 inches, as supplied to the steamships "Prince of Wales" and "Queen Victoria" down to 1¼ inches diameter, as fitted to small piston valves, are also on view. The Lancaster metallic packings, suitable for rods ¼ inch to 11½ inches in diameter, and for all speeds and pressures at present in use, are also exhibited, together with Lancaster steam separators and driers from 1 inch to 6 inches bore. A small engine is also shown at work, having each of the specialties named fitted to it, so that they may be examined and tested under working conditions.

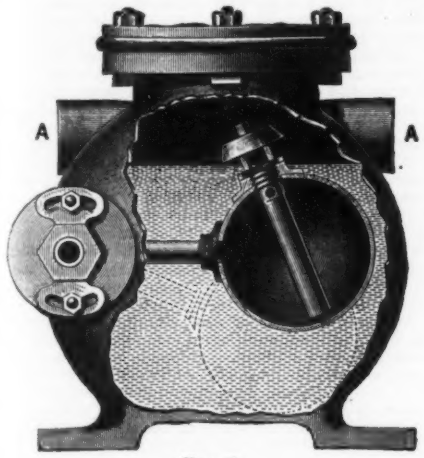


FIG. 1.

The Lancaster steam trap is so well known that a detailed description would be almost unnecessary, if it were not for the fact that several improvements have been recently effected in its construction and action. The specialty of the Lancaster steam trap consists in the loose discharge valve at the orifice of the discharge pipe, in connection with a quick-threaded screw motion worked by the float. This valve is frictionless in action and, being loose, cannot stick to its seat. It is very prompt in its movements for opening and closing the discharge pipe, and the working parts are very simple and easily examined. It also acts as a safety valve, as any excessive pressure exerted against the face of the loose discharge valve would, by virtue of the quickness of the screw thread, force it open. Fig. 1 shows the marine steam traps.

The construction of the trap is as follows: A copper ball, having a small hole at the bottom and a down pipe fitted with valve as shown, also with a small bell on the top for deflecting the discharge water so that the cover can be taken off and the trap examined while working, is connected by an elbow pipe to a hollow quick-threaded spindle, at the end of which is placed a loose valve, alternately forced to its seat and released by the rising and falling of the ball rotating the quick-threaded screwed spindle. By opening or shutting the tubular air valve on the top of the ball, the temperature and quantity of water delivered can be regulated as desired. **Over 70,000 of the traps have been supplied.**

The well-known Lancaster rings and spiral springs are shown at work also in an open cylinder fitted with vacuum and pressure gage for testing purposes. Five types of piston bodies are shown. The steel piston, Fig. 2, as used for marine purposes is of the conical type and is fitted with gun-metal nuts to the junk cover screws. The Lancaster metallic packings are shown in section so as to fully illustrate their application. They are also shown at work fitted to the rods of an engine on the stand, and are fitted to other engines in the exhibition.

Figs. 3 and 4 show the Lancaster metallic packings applied to a cylinder cover, which has been arranged to

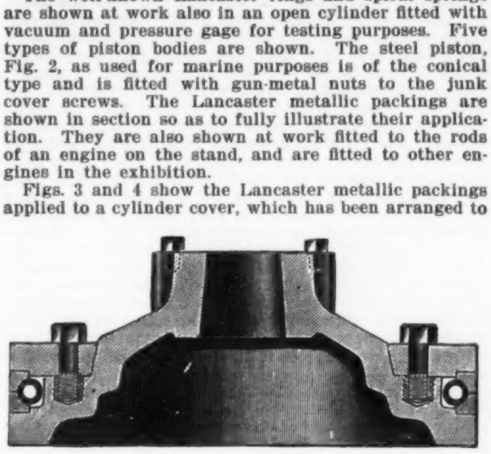


FIG. 2.

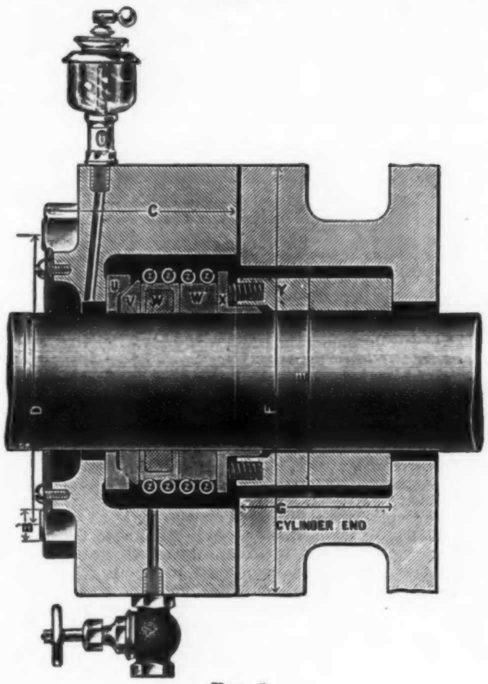


FIG. 3.

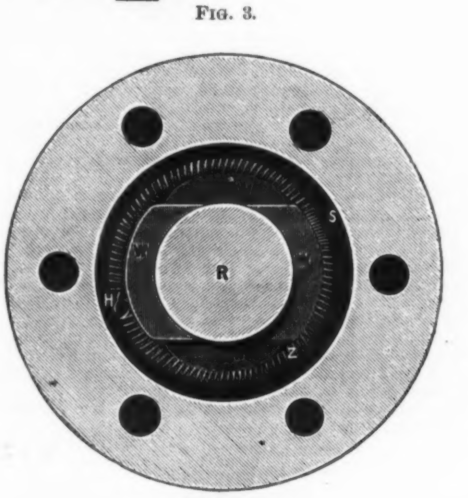


FIG. 4.

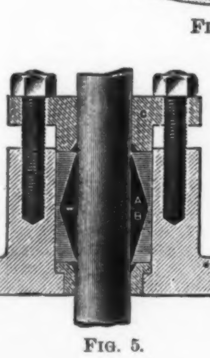


FIG. 5.

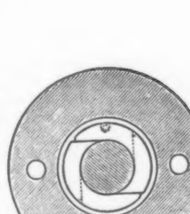


FIG. 6.

receive ordinary packings. The clearance space left for the latter is filled by means of a bush, *Y*, and the metallic packing is placed in a casing bolted to the front of the stuffing-box by studs, making a steam-tight joint against same. At the front of the casing are placed two washers, *U* and *V*, which together form a ball joint, and the front of casing is bored much larger than the piston rod, *R*. Thus provision is made for any lateral or other movement of the rod that may take place owing to the same being out of line with the cylinder. Next to *U* and *V* the metallic blocks, *W* (lined with anti-friction metal), are placed. They are pressed to the rod by the springs, *Z*, and the large blocks keep the rod steam-tight, while the small side blocks keep the joints on each side of the large blocks steam-tight. Behind the blocks is placed a washer, *X*, which is pressed against them, and the washers before described, by means of the springs in *Y*, thus keeping all the joints at right angles to the axis of the piston rod steam-tight. The springs, *Z*, are made in halves, and of square steel. The two halves are screwed together at *S*, and by screwing them to a greater or less extent in each other, the strength of the springs, when hooked together at *H*, can be varied to suit different pressures.

The Lancaster packings have been supplied to the British and foreign navies, and to the principal steamship companies. The following list of principal marine users is issued by the firm: British navy, H. M. S. "Powerful" and "Terrible" (refrigerating engines); German navy, H. M. S. "Nymphi" (main engines); Russian navy, "Askol" (main engines); Dutch navy, several cruisers; Hamburg-American S. S. Co., steamship "Patricia"; North German Lloyd S. S. Co., steamships "Bremen," "Kaiser Frederick," "Grosser Kurfuerst," "Hanover," "Rajaburi" and "Neckar"; Harland & Wolff, Belfast, several vessels; Wigham, Richardson & Co., Newcastle; Glasgow & S. W. Ry Co., several vessels on the Clyde; L. & N. W. & L. & Y. Steamers, Fleetwood & Belfast, several vessels; Union S. S. Co., Southampton, several vessels.

For very small piston rods, valve spindles, air-pump, and other rods, the Lancaster composite metallic packings are exhibited. Figs. 5 and 6 are sections of the packing along and across the rod. It consists of two conical metallic rings, *A* and *B*, each in halves, and having the joints between the halves tangent to the rod, thus enabling the metallic blocks to close on the rod to compensate for wear by sliding on each other as in the case of the spring packings. The blocks or rings, *A* and *B*, are held to the rod by a semi-metallic or composite packing, which is forced behind them by the gland, *C*, in the ordinary manner.

The Lancaster serpent coil is made from round steel, and has many advantages over the old style made from flat steel. The serpent coil has one advantage over the spiral spring, if fitted to a new cylinder that is parallel, as the internal friction between the spring tends to keep the cylinder parallel, while the spiral spring beds itself to the slightest inequality of the cylinder.

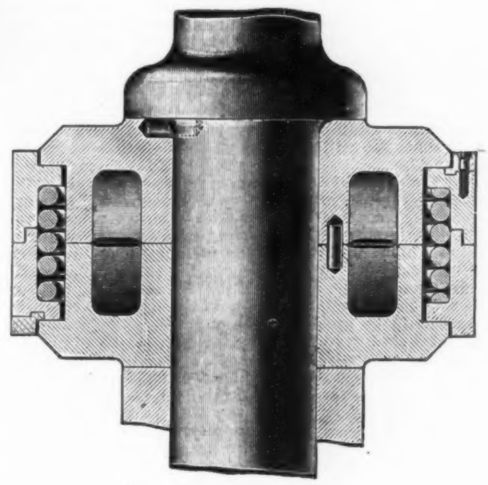


FIG. 7.

This property of the serpent coil has been turned to advantage in the Lancaster patent piston valve shown in Fig. 7. When the spring is coiled only twice round inside the piston rings the resistance to collapse will practically equal the outward pressure exerted by the spring, but if coiled say six or seven times round, as shown, the resistance to collapse will be enormous compared with the active outward pressure exerted by the spring. It is found that a resistance to collapse of 200 pounds to the square inch can be combined with an active outward pressure of less than two pounds per square inch. This is found to be sufficient for all practical purposes.—The Steamship.

MERCANTILE AUXILIARIES.*

By LORD BRASSEY, K.C.B., PAST PRESIDENT.

In bringing forward proposals for a more vigorous policy in relation to mercantile auxiliaries, I return to a subject in which, following the lead of Sir Nathaniel Barnaby and other authorities, I have long been deeply interested.

The history of the question may be briefly traced. The earliest contracts for the conveyance of the mails required that postal vessels should be suitable for conversion into armed cruisers. In 1853, upon the recommendation of the committee on postal contracts, those wise stipulations were withdrawn. It is a notable circumstance that, at the same date, iron was condemned as a material for the construction of fighting ships. After the lapse of a quarter of a century, the subject was taken up by Sir Nathaniel Barnaby. His views were presented for the consideration of this Institution in a paper, read in the Session of 1877, on the fighting power of the merchant ship. Sir Nathaniel Barnaby insisted on the impossibility of providing adequately for the protection of our vast commerce with regularly-built vessels of war. It was impossible to say what number of fast cruising ships would be sufficient for England, seeing that we should never know in what part of the world we should be attacked. It was necessary, therefore, to supplement—and largely to supplement—our regular cruisers with auxiliary vessels. Sir Nathaniel Barnaby's recommendation found powerful supporters.

* Paper read before the Institution of Naval Architects.

Admiral Sir Frederick Gray spoke as follows: "Having been at the Admiralty, and having felt the difficulty of providing, even in peace time, the force necessary to fulfill the various duties devolving on our ships of war, I think it would be utterly impossible to provide sufficient protection for our mercantile marine in time of war. I believe that the merchant steamers of England, if strengthened and fitted as proposed by Mr. Barnaby, would be very useful. I do not say that they would take the place of men-of-war, but they would be most useful as auxiliaries." In the same discussion Sir Spencer Robinson, then the comptroller of the navy, expressed himself in these words: "Those splendid ships which pass between the United States and England with very great speed, and a coal-carrying capacity far exceeding the coal-carrying capacity you can give to any unarmored man-of-war, could be made capable of carrying such an armament as would protect them from the attacks of vessels of a similar class to their own."

These views of the naval advisers of the admiralty, vainly urged a generation ago, have been fully shared, and practically adopted, by the naval advisers of foreign powers. I may quote the remarks of Admiral Fournier in his able pamphlet entitled, "La Flotte Nécessaire:" "As types of fast cruisers for the destruction of commerce, I know of nothing which more fully meets the requirements than those magnificent Transatlantic steamships, the "Lucania" and "Campania," capable of maintaining a speed of 22 knots an hour with extraordinary uniformity. The "New York," "Paris," "St. Louis," and "St. Paul," and the English ships "Majestic" and "Teutonic," possess the same qualities, though in a somewhat less degree of perfection. Such ships will, in my view, be the destroyers of commerce in the future."

While their chief naval and technical advisers were endeavoring to obtain the assent of the Board of Admiralty to some practical action, the subject was not neglected out of doors. In 1878 a paper was published in the Nautical Magazine by the late Lord Inverclyde. I quote his weighty words, as true to-day as when they were written: "There never was a time in the history of this country when the subject of the efficiency of the royal navy occupied a position of greater importance than it does at present. Our risks lie in the fact that the fleets of other nations are fast becoming powerful and reliable; and while no navy can numerically approach that of this country, yet there are nations in Europe whose fleets combined would undoubtedly give us enough to cope with. How, then, can we stride ahead as the greatest maritime power, and hold our own against the fleets of the world? Not by being satisfied with increasing the strength of the navy proper, which, owing to the prodigious cost of modern war vessels, can only be done in a comparatively small degree. But what cannot be accomplished in that direction can be attained by other means ready to our hand, and that by utilizing the vessels of the mercantile marine."

At the date of Lord Inverclyde's paper the cost of our most powerful cruisers was under a quarter of a million. The cost of the first-class cruisers we are now building is more than threefold greater. The practical steps which Lord Inverclyde recommended to the admiralty are briefly described in his paper. There was wanted a scheme by which the advantage of the vast fleet of merchant steamers now belonging to the country should be conserved for our special requirements, and it was due to our naval authorities to admit that they had recognized that there were numerous British vessels which could easily be converted into cruisers. There was, however, one fatal flaw in the admiralty plan—they wanted to have the use of the ships without paying an adequate consideration. As Lord Inverclyde put it: "It was not to be supposed that a position for their vessels on the select list would be a sufficient inducement to comply with admiralty requirements, and to incur the expense involved in exacting the requisite alterations. War being only a contingency more or less remote, a retaining fee must be offered." It was proposed by Lord Inverclyde that subsidized steamers should be built to meet certain requirements, including increased bulkheads and water-tight compartments. The ships should be manned by seamen of the royal naval reserve, who should be thoroughly trained in gunnery at the respective home ports of the companies or owners.

The subject of mercantile auxiliaries continued to attract the attention of our highest authorities on naval administration. In 1880 Sir Donald Currie read an exhaustive paper at the United Service Institution. He referred to the general increase in naval preparations. France had increased her navy; Germany and Russia were making large strides in the direction of more powerful naval forces. Quite recently the Russian volunteer fleet had been originated by Prince Dolgorouki, the Governor-General of Moscow. He addressed himself to the wealthy merchants of that ancient capital, appealing to their patriotism, and a volunteer cruisers' fund had been raised. Sir Donald Currie submitted a scheme for the retention of swift merchant cruisers by an annual subsidy.

I may refer to another shipowner, most eminent in that branch of enterprise with which he was connected. I refer to the late Mr. Ismay. In the evidence which he gave before the royal commission on coaling stations he truly said: "When a company has not been doing well, and has got heavy bills running which it cannot meet, the temptation to shut its eyes to what would be the ultimate destination of ships sold to foreigners in a crisis would be very great. At the commencement of the Russian scare, on the occasion of the Penjdeh incident, great temptations were offered to the owners of the White Star steamers running between San Francisco and Japan; and it was not too much to say that our whole commerce in the Pacific would have been transferred to the flag of the United States if that offer had been accepted." The British ownership of a magnificent steamship is a slight national tie. It binds to no national service while it exists, and it may be broken without warning at the will of the owners. These considerations may be pleaded as a strong argument in support of the policy of binding all our finest vessels to the service of the State as mercantile auxiliaries.

Passing on to the later authorities, the practicability of so constructing merchant steamers as to render them readily available for war purposes was discussed by Mr. Biles in a paper read at an engineering conference, held under the auspices of the Institution of Civil Engineers in June, 1899. Arguing from the results of arming and fighting the mercantile cruisers of the United States navy, Mr. Biles takes the view that such vessels are not unable to cope with thoroughbred warships. The experiences of modern sea fights point to the conclusion that a ship is more liable to be disabled by her crew being driven from their guns than to be sunk by the effects of shell-fire. The issue of a fight between a warship and a merchant ship may not turn on the relative efficiency of the internal subdivision, but on the protection of the guns. By placing the guns in a box battery, as the Americans did, a considerable number of guns could be as well protected in merchant ships as in first-class cruisers. Mr. Biles holds it to be practicable, with due consideration in the early stages of design and construction, to so protect machinery and armament that the merchant ship need not be much, if at all, inferior to many warships.

The policy of liberal subsidies to the mercantile marine has given to the merchant navies of foreign powers a decided advantage in the possession of the types of vessels most suitable for naval purposes. The Germans have taken the lead. They have two ships now running—the "Deutschland" and the "Kaiser Wilhelm," of 14,000 tons and 15,000 tons respectively—which exceed in speed by nearly 2 knots our best ships. No vessel now building for the British flag will rival in speed the "Kaiser Wilhelm II." and "Kronprinz Wilhelm" under construction in Germany.

Of ships capable of a regular sea speed of over 18 knots, France has 4, Germany 8, and Great Britain 10.

Taking vessels above 3,000 tons only, Lloyd's statistics, as quoted by Mr. Biles, give the relative positions as follows:

	British.	Foreign.
20 knots and over	6	6
19 to 20 knots	1	11
18 to 19 knots	9	4
17 to 18 knots	22	18
16 to 17 knots	17	18
	—	—
	55	57

It is an ominous fact that in the last eight years we have added only one ocean-going 18-knot ship to our navy, while Germany has built four in the last four years. It is another ominous fact that, while we equal the combined merchant navies of the world in aggregate tonnage, of the 157 ships of 16 knots and over less than one-half the number are under the British flag. If we examine the lists of mercantile auxiliaries of the several powers, we find that France has 32 vessels, the latest additions, the "Lorraine" and "Savoie," having a displacement of over 11,000 tons. The speeds of the French subsidized steamers have been constantly increasing from the 15 knots of twenty years ago to the 17, 18, and 19 knots of modern types. The armaments provided for each ship include seven 5.5-inch guns and smaller quick-firers. In numbers the German auxiliaries do not compare with the French. There are, however, six ships of the first class, which, as it has already been observed, hold the record in the international competition on the North Atlantic. The armaments prepared for the German mercantile auxiliaries include eight 5-inch guns, four 4.7-inch, four smaller quick-firers, and fourteen machine guns. The Russian fleet of auxiliary steamers consists of twenty-five vessels. In displacement each of these ships exceeds 10,000 tons, with speeds of 19½ to 20 knots. The British list of reserve merchant cruisers compares unfavorably with those of foreign powers. It consists of twenty-nine vessels, none being fitted with special protective arrangements.

With these comparisons before us, we must regret that so little heed should have been paid to the counsels of the able men to whom I referred in the opening of this paper; how little is attested by the fact that the amount payable to the owners of our reserve merchant cruisers under the naval estimates now before Parliament is £63,000, out of a total of £2,000,000, which Parliament is asked to vote for the navy.

While we have taken no adequate measures to create a fleet of mercantile auxiliaries by the appropriation of moneys directly voted from navy estimates, we have been sparing in our grants for postal services. The amounts paid have been computed by Mr. Henniker-Heaton, M.P., as follows:

Countries.	Money.	Total Value of the Foreign Trade.
France	£1,143,000	£300,000,000
Germany	1,000,000	313,000,000
Russia	251,000	111,000,000
Italy	400,000	182,000,000
Great Britain	637,000	750,000,000

The last returns show no material changes in the figures given by Mr. Henniker-Heaton.

And now let us ask ourselves what steps it is practicable to take in furtherance of the policy which it has been the object of the present paper to recommend. And first, what is the proper sphere of action of the mercantile auxiliary? It was described by Lord George Hamilton in moving the navy estimates for 1889. They would be employed in dogging the footsteps of a foreign rover and embarrassing a foe; they would act as the scouts of the fleet. "The difficulty of keeping touch with a squadron has been strongly impressed in recent maneuvers. As scouts and patrol vessels, their long coal endurance would give to the mercantile auxiliaries an advantage over regularly-built vessels of war of even tonnage. Such being the rôle of the mercantile auxiliary, the qualities required are speed, coal endurance, internal subdivision up to admiralty requirements, strength of hull. Guns must be carried at such a height above water as to be of service in a seaway. Lastly, there is the absolute requirement of protection from the shot and highly-explosive shell of quick-firing guns. The power of modern armaments to reduce unarmored superstructures to wreckage, to disable guns, and annihilate guns' crews has been signally shown in the battles of Manila and Santiago.

If the requirements were carefully considered in the original design, it would be possible to give as much, or nearly as much, protection to the mercantile auxiliary as to the regularly-built cruiser. Mr. Peskett, of the Cunard Company, has recently offered some practical suggestions on this subject in a lecture delivered at Liverpool. Mr. Peskett is a strong advocate for subsidies to mercantile auxiliaries, conditional upon the adaptation of the ships to the requirements of naval warfare. I may quote from a *precis* of his lecture:

"Merchant ships of the 'Campania' or 'Saxonia' class could actually be built lighter than they are under the present system if they were built with one very strong deck, such as a protective deck with sloping sides, or with a deck of cellular form. The disposition of material in some of our large steamers is not, perhaps, in strict accordance with the best designs our naval architects could produce, but entirely due to the requirements of owners and the various registration societies. I should say that a cruiser's hull with protective deck is lighter in proportion to her displacement than that of many of our first-class passenger steamers.

"Taking into consideration the fact that our supremacy depends on the efficiency of our naval and mercantile marine, a committee of admiralty officials, shipowners, and shipbuilders should be formed to discuss the best method of constructing a combined naval and mercantile marine, and to consider whether ships could be built as merchant cruisers, with protective decks, ram stems, machinery, and steering gear below the water-line, and still be able to carry enough passengers and mails, which, with a reasonable subsidy, would make the ships remunerative to owners.

"These ships would have to be permanently mounted with light guns, racer plates for heavier armaments being built in the ships during construction, the heavier guns and mountings being kept at ports of call, and made to suit the various ships of any particular fleet."

It has always been recognized that mercantile auxiliaries cannot be effective unless specially designed for conversion into cruisers. In the discussion at the Institute of Naval Architects on Mr. Barnaby's paper already referred to, Sir Edward Reed proposed that shipowners about to build large and swift merchant vessels should be invited to submit their plans to the admiralty. The cost of any alterations which they might be willing to make in order to adapt these vessels for the emergency of war service should be met by a grant from the government.

It is the main object of the present paper to urge the adoption of valuable and practical recommendations, which have been too long neglected. It is the fixed resolve of the people, and perhaps the first duty of British statesmen, to keep the empire secure from attack, and to give protection to the commerce on which our existence depends. In pursuance of this policy we have more than doubled the expenditure under navy estimates, and still we seem to fall short of the full requirements for the naval defense of the empire. It would be impossible to fix a limit to the number of cruisers required for the protection of a commerce which, extends over every sea. The construction of cruisers has absorbed in recent years a large proportion of the shipbuilding votes. But when the cost of the first-class types falls little short of that of the battleship, the numbers we can build are all too few for the work they might be required to do. We cannot cut down the expenditure on battleships.

If, therefore, our regular-built cruisers are fewer than we could wish, we must look to our own mercantile marine, and, out of the abundant materials we there find ready to our hands, we may organize a supplementary fleet of armed cruisers such as no other state can furnish. The admiralty should utilize these resources by liberal subsidies. The standard of requirements should be high. The speed should not be less than that of the "Deutschland"—let us say, 22 knots at sea. Mercantile auxiliaries should be protected by a deck or belt of Harveyized armor—the necessary armaments should be in readiness. Calculations of cost can hardly be attempted in a paper in which nothing more is attempted beyond suggesting a policy. This, at least, is certain, that the cost of the adaptations and protective arrangements necessary in a mercantile auxiliary will be small in comparison with the first cost of a regularly-built vessel of war. For a first-class cruiser we may take the cost at three-quarters of a million. Allowing 3½ per cent on the money invested, adding 6 per cent for depreciation, and 1 per cent for insurance, we have in round figures for the first cost an annual writing down charge of £70,000 a year.

In addition, there is the cost of maintenance, which, whether in commission or in reserve, will certainly be considerable. Allowing for the protective arrangements of the mercantile auxiliary the liberal sum of £50,000, and a writing down charge on this amount of 10 per cent, and taking 10s. per ton displacement for the annual retainer, we have, for a mercantile cruiser of 10,000 tons, an annual charge of £10,000. We must further take into view the economy resulting from the maintenance of the mercantile auxiliary by the shipowners, as against the maintenance of the man-of-war in our royal yards. In conclusion, I claim that it has been clearly shown that we can have many auxiliaries for the cost of one cruiser; and these auxiliaries may have effective protection. If not equal to the ship of war as combatants, they will be superior in coal endurance and probably in speed for long distances. They would be the scouts of our fighting squadrons. They would protect our commerce from interruptions by the auxiliary vessels of a hostile power.

While the building of cruisers for the navy should be continued, the resources we possess in the marine, which our maritime enterprise has created in extent practically without limit, should not be neglected. Here, in Glasgow, I look for powerful support to a policy not now presented for the first time to the consideration of the Institute of Naval Architects. It has been advocated for many years by your ablest men, it is being steadily pursued, to their signal advantage, by every naval administration: we are lagging behind, how seriously, has been shown by the figures which I have quoted. If the expenditure on auxiliary cruisers were raised from £60,000 to £600,000 a year, in a few years we should be enabled to provide no ineffective protection for our vast trade.

ABSTRACT OF STATISTICS OF THE RAILWAYS IN THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1900.

FROM summaries which will appear in the Thirteenth Statistical Report of the Interstate Commerce Commission, prepared by its statistician, being the complete report for the above-named period, for which a preliminary income account was issued in December, 1900, the figures in the following advance statement are obtained:

Nearly eighty summaries of railway statistics will appear in the text of the report. For the purpose of localizing statistics, data are, as a rule, presented for each of the ten territorial groups into which the country is divided, as well as for the United States as a whole. In the body of the report will appear the usual tables giving mileage, capitalization, earnings, expenses, etc., by roads.

RAILWAY RECEIVERSHIPS.

The number of railways in the hands of receivers on June 30, 1900, was 52, there being a net decrease of 19 as compared with the corresponding date of the previous year. The number of railways placed in charge of receivers during the year was 16, and the number removed from their management was 35. The operated mileage of the roads under receivers on June 30, 1900, was 4,177.91 miles, of which 3,640.32 miles were owned by them. Of these roads 5 had an operated mileage in excess of 300 miles, 7 between 100 and 300 miles, and 30 less than 100 miles. Complete returns for roads in the custody of the courts are not always available, but from the data at hand it appears that the capital stock represented by railways under receivership on June 30, 1900, was $108,096,855, funded debt $107,393,022, and current liabilities $35,531,620. These figures show a decrease in capital stock represented, as compared with the previous year, of $112,113,833, and in funded debt of $199,093,718.

MILEAGE.

On June 30, 1900, the total single-track railway mileage in the United States was 193,345.78 miles, an increase during the year of 4,051.12 miles being shown. This is a greater increase than that for any other year since 1893. The States and Territories which show an increase in mileage in excess of 100 miles are Alabama, Arkansas, California, Idaho, Illinois, Iowa, Louisiana, Minnesota, Mississippi, Nebraska, North Carolina, Oregon, Pennsylvania, South Carolina, Texas, and Oklahoma. Practically all of the railway mileage of the country is covered by reports made to the Commission, the amount not covered being 789.75 miles, or 0.41 per cent of the total single-track mileage. The aggregate length of railway mileage, including tracks of all kinds, was 259,788.07 miles. The distribution of this aggregate mileage was as follows: Single-track, 193,345.78 miles; second track, 12,151.48 miles; third track, 1,094.48 miles; fourth track, 829.29 miles; and yard track and sidings, 52,367.04 miles.

CLASSIFICATION OF RAILWAYS.

The number of railway corporations included in the report was 2,023. Of this number 1,067 maintained operating accounts, 847 being classed as independent operating roads and 220 as subsidiary roads. Of roads operated under lease or some other form of contract 324 received a fixed money rental, 167 a contingent money rental, and 241 were operated under some form of agreement or control not readily classified. The operated mileage of roads merged, reorganized, or consolidated during the year was 9,546.90 miles. The corresponding figure for 1899 was 5,846.35 miles.

EQUIPMENT.

There were 37,663 locomotives in the service of the railways on June 30, 1900, or 960 more than the year previous. Of the total number reported 9,863 are classed as passenger locomotives, 21,596 as freight locomotives, 5,621 as switching locomotives, and 583 are not classified.

The total number of cars of all classes in the service of the railways on the same date was 1,450,838, an increase of 74,922 being shown in this item. Of the total number, 34,713 are assigned to the passenger service, 1,365,531 to the freight service, and 50,594 to the direct service of the railways. It should be understood, however, that cars owned by private companies and firms and used by railways are not included in the returns made to the Commission. The report contains summaries which will indicate the density of equipment and the extent to which it is used. It appears that the railways of the United States used on an average 20 locomotives and 753 cars per 100 miles of line; that 58,488 passengers were carried, and 1,626,179 passenger miles accomplished per passenger locomotive; and that 51,013 tons of freight were carried and 6,556,731 ton miles accomplished per freight locomotive. All of these items show an increase when compared with corresponding figures for the year 1899. There was also a decrease in the number of passenger cars per 1,000,000 passengers carried, and a decrease in the number of freight cars per 1,000,000 tons of freight carried.

Both locomotives and cars being embraced in the term equipment it appears that the total equipment of the railways on the date referred to was 1,488,501. Of this number 1,005,729 were fitted with train brakes, the increase in this item being 197,655, and 1,404,132 were fitted with automatic couplers, the increase being 266,413.

Practically all locomotives and cars in the passenger service were fitted with train brakes, and of 9,863 locomotives assigned to that service 7,431 were fitted with automatic couplers. Nearly all passenger cars were fitted with automatic couplers. With respect to freight equipment, it is noted that nearly all freight locomotives were equipped with train brakes and 75 per cent of them with automatic couplers; the corresponding figure one year previous was 45 per cent. Of 1,365,531 cars in the freight service June 30, 1900, 920,465 were fitted with train brakes, and 1,307,559 with automatic couplers.

EMPLOYES.

The number of persons employed by the railways of the United States, as reported for June 30, 1900, was 1,017,653, or an average of 529 employes per 100 miles of line. As compared with the number employed on June 30, 1899, there was an increase of 88,729, or 34 per 100 miles of line. From the classification of these employes it appears that 42,837 were enginemen, 44,130 firemen, 29,957 conductors, and 74,274 other trainmen. There were 50,789 switchmen, flagmen, and watchmen.

Disregarding 8,394 employes not assigned to the four general divisions of employment, it is found that the services of 36,451 employes were required for general administration; 324,946 for maintenance of way and structures; 197,799 for maintenance of equipment, and 450,063 for conducting transportation.

The report will contain a statement of the average daily compensation of the eighteen classes of employes for the nine years beginning with 1892. Another summary gives the total compensation of more than 99 per cent of railway employes, for the fiscal years 1895 to 1900. During the year ending June 30, 1900, $577,264,841 were paid in wages and salaries, an amount $131,756,580 in excess of that paid during the fiscal year 1895. The compensation of the employes of railways for the fiscal year 1900 represents 60 per cent of the operating expenses of the roads and 39 per cent of their gross earnings.

CAPITALIZATION AND VALUATION OF RAILWAY PROPERTY.

The amount of railway capital outstanding June 30, 1900, was $11,491,034,960. This amount assigned to a mileage basis represents a capitalization of $61,490 per mile of line. Of this amount $5,845,579,593 existed in the form of stock, of which $4,522,291,838 was common stock and $1,323,287,755 preferred stock. The amount which existed in the form of funded debt was $5,645,455,367. This amount was classified as mortgage bonds, $4,900,626,823; miscellaneous obligations, $464,983,341; income bonds, $219,536,883; and equipment trust obligations, $60,308,320. The amount of current liabilities not included in the foregoing capital statement was $594,787,870, or $3,183 per mile of line.

The amount of capital stock paying no dividend was $3,176,609,698, or 54.34 per cent of the total amount outstanding. The amount of funded debt, excluding equipment trust obligations, which paid no interest, was $378,937,806. Of the stock paying dividends, 10.18 per cent of the total amount outstanding paid from 1 to 4 per cent, 14.56 per cent paid from 4 to 5 per cent, 6.93 per cent paid from 5 to 6 per cent, 4.29 per cent paid from 6 to 7 per cent, and 6.40 per cent paid from 7 to 8 per cent. The amount of dividends declared during the year was $139,597,972, which would be produced by an average rate of 5.23 per cent on the stock on which some dividend was declared. The amount of mortgage bonds paying no interest was $266,874,623, or 5.44 per cent; of miscellaneous obligations $16,779,175, or 3.61 per cent; of income bonds $95,284,008, or 43.40 per cent.

PUBLIC SERVICE OF RAILWAYS.

The number of passengers carried during the year ending June 30, 1900, as shown by the annual reports of railways, was 576,865,230, showing an increase for the year of 53,688,722. The number of passengers carried one mile—that is, passenger mileage—was 16,039,007,217, there being an increase in this item of 1,447,679,604. There was an increase in the density of passenger traffic, as the number of passengers carried one mile per mile of line in 1900 was 83,295, and in 1899 77,821.

The number of tons of freight carried during the year was 1,101,680,238, an increase of 141,916,655 being shown. The number of tons of freight carried 1 mile—that is, ton mileage—was 141,599,157,270. The increase in the number of tons carried 1 mile was 17,931,900,117. The number of tons carried 1 mile per mile of line was 735,366. These figures show an increase in the density of freight traffic of 75,801 tons carried 1 mile per mile of line.

The report contains a summary of freight traffic analyzed on the basis of commodity classification, and also a summary indicating in some degree the localization of the origin of railway freight by groups of commodities.

The average revenue per passenger per mile for the year ending June 30, 1900, was 2.003 cents. For the preceding year it was 1.925 cents. The revenue per ton of freight per mile was 0.729 cent, while for 1899 it was 0.724 cent. An increase in earnings per train mile appears for both passenger and freight trains. The average cost of running a train 1 mile increased nearly 9 cents as compared with 1899. The percentage of operating expenses to earnings shows a small decrease as compared with the preceding year.

EARNINGS AND EXPENSES.

For the year ending June 30, 1900, the gross earnings from the operation of the railways in the United States, covering an operated mileage of 192,556.03 miles, were $1,487,044,814, being $173,434,696 more than for the preceding fiscal year. The operating expenses were $961,428,511, the increase in this item being $104,459,512. The details of gross earnings were as follows: Passenger revenue $323,715,639—increase as compared with the preceding year $32,602,646; mail $37,752,474—increase $1,753,463; express $28,416,150—increase $1,660,096; other earnings from passenger service $8,161,022—increase $473,659; freight revenue $1,049,256,323—increase $135,519,168; other earnings from freight service $3,345,912—decrease $915,892; other earnings from operation, including unclassified items, $36,397,294—increase $2,341,556. Gross earnings from operation per mile of line were $717 more than for the year ending June 30, 1899, being $7,722.

The operating expenses of the railways for the year under review were distributed as follows: Maintenance of way and structures $211,220,521, increase $30,809,715; maintenance of equipment $181,173,880, increase $30,254,631; conducting transportation $529,116,326, increase $42,956,719; general expenses $39,328,765, increase $651,882; undistributed $589,019. The operating expenses for the year in question were $4,993 per mile of line, or $423 more than for the previous year. An analysis of operating expenses for the year ending June 30, 1900, according to the fifty-three accounts embraced in the official classification, appears in the report, with a statement of the percentage of each item of the classified operating expenses for the years 1895 to 1900, inclusive.

The income from operation, or amount of gross earnings remaining after the deduction of operating expenses, generally designated as net earnings, was $525,616,303, an increase as compared with the preceding year of $68,975,184. The average amount per mile of line for the year ending June 30, 1900, was $2,729, and for 1899, $2,435. The amount of income received from sources other than operation was $162,885,071. This amount embraces the following items: Income from lease of road, $99,429,619; dividends on stocks owned, $24,490,253; interest on bonds owned, $11,833,974; miscellaneous income, $27,131,225. The total income of the railways, $688,501,374—that is, the income from operation increased by the income from other sources—is the item from which fixed charges and analogous items are deducted in order to reach the amount available for dividends. The total of these deductions was $461,240,927, leaving $227,260,447 as the net income for the year available for dividends or surplus.

The amount of dividends declared during the year (including $4,542 other payments from net income) was $139,602,514, leaving as the surplus from the operations of the year $87,657,933, the corresponding surplus for the year ending June 30, 1899, having been $53,064,877.

The deductions from income, $461,240,927, already mentioned, comprised the following items: Salaries and maintenance of organization, $520,102; interest accrued on funded debt, $252,949,616; interest on current liabilities, $4,912,892; rents paid for lease of road, $101,951,319; taxes, $48,332,273; permanent improvements charged to income account, $25,500,035; other deductions, $27,074,690.

The report will contain a summary of taxes paid by railways, the gross amount and the amount per mile of line being given for each State. From this it appears that, disregarding taxes paid to the United States Government under the recent internal-revenue act and small amounts not apportioned by States, there accrued against the railways of the United States during the fiscal year in question taxes to the amount of $47,415,433, or an average tax of $254.78 per mile of line.

In the consideration of the foregoing figures pertaining to income and expenditure it should be held in mind that annual reports of two kinds are made to the Commission by railway companies. Operating reports are filed by such companies as maintain full operating accounts, and financial reports by such companies as have leased their property to others for operation, their own income, apart from that derived from investments, being the annual fixed or contingent rental paid by their lessees, from which they make their own disbursements. In consequence, certain items of income and expenditure are necessarily duplicated in comprehensive summaries which are compiled from reports of both classes. The source and extent of such duplications are clearly indicated by the statistician. His report contains also an income account of the railways of the United States, considered as a system. The figures in this account are such as would be presented were the railways owned by the government—operations, tariffs, and expenses remaining the same. They eliminate intercorporate payments by making use, where necessary, of balance amounts.

RAILWAY ACCIDENTS.

The total number of casualties to persons on account of railway accidents during the year ending June 30, 1900, was 58,185. The aggregate number of persons killed in consequence of railway accidents during the year was 7,865, and the number injured was 50,320. Of railway employes 2,550 were killed and 39,643 were injured. With respect to the three general classes of employes, these casualties were distributed as follows: Trainmen, 1,396 killed, 17,571 injured; switchmen, flagmen, and watchmen, 272 killed, 3,060 injured; other employes, 882 killed, 19,012 injured. The casualties to employes resulting from coupling and uncoupling cars were: Number killed, 282; injured, 5,229. The corresponding figures for the preceding year were: Killed, 260; injured, 6,765.

The casualties from coupling and uncoupling cars are divided as follows: Trainmen, killed 188, injured 3,803; switchmen, flagmen, and watchmen, killed 77, injured 1,264; other employes, killed 17, injured 162. The casualties due to falling from trains and engines are assigned as follows: Trainmen, killed 412, injured 3,359; switchmen, flagmen, and watchmen, killed 45, injured 501; other employes, killed 72, injured 565. The casualties to the same three classes of employes from collisions and derailments were as follows: Trainmen, killed 380, injured 1,867; switchmen, flagmen, and watchmen, killed 11, injured 141; other employes, killed 70, injured 445.

The number of passengers killed during the year was 249, and the number injured 4,128. The corresponding figures for the previous year were 239 killed and 3,442 injured. In consequence of collisions and derailments 88 passengers were killed and 1,743 injured. The total number of persons, other than employes and passengers, killed was 5,066; injured, 6,549. These figures include casualties to persons classed as trespassers, of whom 4,346 were killed and 4,680 were injured. The total number of persons killed at highway crossings was 750, injured 1,350, distributed as follows: Employes, 20 killed, 53 injured; passengers, 1 killed, 3 injured; other persons trespassing, 171 killed, 204 injured; not trespassing, 558 killed, 1,090 injured. The number of persons killed at stations was 521, injured 3,836. This statement covers: Employes, killed 113, injured 2,570; passengers, killed 34, injured 646; other persons trespassing, killed 338, injured 393; not trespassing, killed 36, injured 227. The summaries giving the ratio of casualties show that 1 out of every 399 employes was killed, and 1 out of every 26 employes was injured. With reference to trainmen—including in this term enginemen, firemen, conductors, and other trainmen—it is shown that 1 was killed for every 137 employed, and 1 was injured for every 11 employed. One passenger was killed for every 2,316,648 carried, and 1 injured for every 139,740 carried. Ratios based upon the number of miles traveled, however, show that 64,413,684 passenger-miles were accomplished for each passenger killed, and 3,885,418 passenger-miles accomplished for each passenger injured. The corresponding figures in these latter ratios for the year ending June

30, 1899, were 61,051,580 and **4,239,200 passenger-miles** for each passenger killed and **each passenger injured**, respectively.

One summary shows that in the course of thirteen years ending June 30, 1900, in consequence of railway accidents, 86,277 persons were killed and 469,027 persons were injured. The injuries reported varied from comparatively trivial injuries to those of a fatal character. The casualties for the period mentioned occurred to persons as follows: Employes killed 38,340, injured 361,789; passengers killed 3,485, injured 37,729; other persons (including trespassers) killed 54,452, injured 69,509.

GERMINATION IN DISTILLED WATER.

THE experiments on the germination of seeds in distilled water, of which we are about to give the results, were performed last winter by MM. Deherain and Demoussy at the Museum of Natural History of Paris.

It would seem that a seed ought to contain in its cotyledons all the elements necessary for the development of its embryo, and that, provided it be kept damp at a mild temperature in an oxygenated atmosphere, it ought to accomplish its evolution normally. This, however, does not always happen, for if, after seeds of white lupine or of wheat have been allowed to swell in distilled water, we select a few vigorous individuals that are beginning to form their rootlets and stalk and introduce them into funnels and then plunge the root into distilled water, we often observe a complete arrest of development.

When we fill the tubes, not with distilled, but with slightly calcareous water, the roots develop normally.

Herr J. Boehm, an Austrian physiologist, to whom we owe the first observations upon this subject, thought that it might be concluded therefrom that time is necessary for the evolution of seeds in the process of germination.

Several experiments performed twenty years ago showed MM. Deherain and Demoussy that Boehm's opinion was too absolute, but did not permit them to understand the cause of the often observed checks to germination in distilled water.

At the laboratory of physiology of the museum, the experiment was performed with a continuous apparatus, and although the reagents habitually employed did not show the presence of any injurious material, M. Demoussy thought that the liquid might perhaps contain some prejudicial element. So he submitted the water to a new distillation in a glass retort, collected separately the first and second thirds of the condensed liquid and preserved the last third without distilling it. He then filled tubes with these three liquids and allowed white lupines to take root therein.

Fig. 1, which indicates the results obtained, shows conclusively that the lupines formed excellent roots and developed normally in the two first thirds of the distilled water, while there was a complete arrest of development in the last third.

The distilled water evidently contained a noxious principle that remained condensed in the portion that had not been distilled anew, although reagents were powerless to reveal the presence of any of the metals that are known to exert an injurious action upon vegetation. Silver, tin and copper were then placed in leaden vessels, which were filled with distilled water. After a few days the different waters were introduced into tubes, and lupines allowed to take root therein.

Fig. 2 shows the effects observed. In the water that had come into contact with silver, lead and tin the lupines developed normally, and formed as perfect roots as in pure distilled water, but in the water contaminated with copper, on the contrary, there was a complete arrest of development. This cupreous water was likewise poisonous to yellow lupines, wheat and several other plants.

These experiments show the extreme sensitiveness of plants to the presence of imponderable traces of copper in water, and completely confirm those made by M. Henri Coupin several years ago.—For the above particulars and the engravings, we are indebted to La Nature.

THE WARD-COONLEY COLLECTION OF METEORITES.

By L. P. GRATACAP.

PROF. HENRY A. WARD has installed at the American Museum of Natural History the Ward-Coonley collection of meteorites. It is the result of Prof. Ward's personal exertions over a long series of years, and represents an amount of labor, research, indefatigable industry and painstaking ingenuity, of which the average visitor is entirely ignorant. The arts of persuasion, the resources of money, the careful negotiations of the practised buyer, and the unfailing memory of the experienced collector are all necessary for the bringing together of such remarkably exhaustive collections as this.

The collector of meteorites is himself the possessor of an extraordinary enthusiasm. The smallest piece from any visitor from the celestial spaces fills him with immeasurable joy, and he can expend an amount of eloquence, reminiscence, and anecdotal comparisons over a bit of extra-terrestrial iron or stone that seems quite out of proportion to the insignificance of the fragmentary mineral upon which it · lavished. And yet a very little consideration will su ..ce to justify this absorbing interest, and bring to the mind of the most irresponsive spectator a realization of the really wonderful character of these objects.

VIEW OF PROF. H. A. WARD'S COLLECTION OF METEORITES IN THE AMERICAN MUSEUM OF NATURAL HISTORY.

They have come to us from space, from that illimitable void of whose physical condition we know nothing, except as scientific speculation allows us to assign to it absence of atmosphere and an inconceivable degree of coldness. They bring us indubitable evidence of the oneness of the mineral constitution of creation. They are relics of extinct or exploded planets whose long-continued journey in some huge orbit, traversing, perhaps, the limits of our solar system, has been suddenly arrested by our earth, through whose envelope of atmosphere they have plunged in a path of conflagration and reached us as already partially consumed elements of unknown worlds.

And in themselves they furnish reason for our admiration and study. They reveal crystallographic conditions of much novelty; they present us with combinations of elements unknown upon our earth, they suggest an origin which distinctly presents to us the picture of disrupted planetary bodies, while their incessant bombardment of our earth sustains, in a measure, the singular conception that space is not a limitless expanse of emptiness, but that traveling through it, indeed filling it with substance, are these masses to which the exacting and elevated language of astronomy has applied the term "cosmic dust."

The opportunity of visiting all parts of the world, the incessant call of his profession to ransack the available natural treasures of the earth, has permitted Prof. Ward to avail himself of remarkable advantages for the collecting of meteorites. To-day the Ward-Coonley collection represents 511 distinct "falls" and "finds," about five-sixths of all the meteorites known to science, and which, to be all seen, would require a visit to the great museums of the world and many cabinets of private collectors.

It has been arranged with much taste, and an elaboration of the physical accessories (cases, stands, labels), which impart to the lusterless and dark contents a positive beauty.

If we engage in the study of meteorites, a slight inspection of the various examples of this form of mineral matter shows three distinct classes, into which, by very simple examination, we can readily separate it. These are the pure irons, or siderites, the mixtures of iron and silicates (stony material) or siderolites, and those meteorites almost entirely stony or with scattered specks, grains and scales of iron, or aerolites. While Brezina, the accomplished student of meteorites, has produced a separation of these objects into sixty-one kinds or classes, Prof. Ward has naturally followed the obvious and simple plan given above.

Meteoric irons, or siderites, form the more striking and attractive feature of this collection. They are those celestial visitors which are composed of iron and nickel, and which when cut and polished and etched with acid, reveal in varying degrees of clearness the crystallographic constitution of the mass, in the Widmanstätten figures. These figures are bands, lines or ribbon-like areas on the surface of the iron, intersecting in such geometrical relations as to produce the impression of hexahedral or octahedral crystallization, while between their lustrous bars are embraced dull spaces of a different composition.

There are in fact three separable compounds of iron and nickel in the siderites, which have been designated in the order of their percentage of nickel as taenite, plessite, and kamacite, the "triad" of Reichenbach. The taenite on etched surfaces appears as a narrow fillet, and from its higher percentage of nickel resists the action of the acid more fully than its associates. The kamacite forms the broader bands; and the plessite, a doubtful body, the interior cell fillings.

Superb examples of the holosiderite section of the meteorites are shown by Prof. Ward; and the etched surfaces reveal the curious crystallization, hitherto unattained in fused irons by artificial means, of these metallic masses. As a rule these irons are uniform in constitution (monogenic); but examples occur, as in

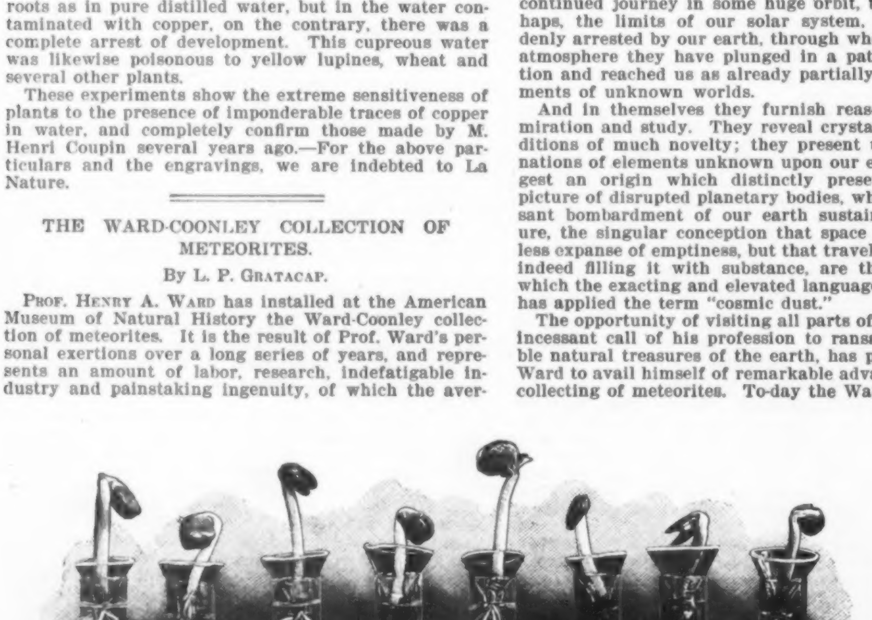


FIG. 1.—The tubes to the left were filled with the two first thirds of water distilled in glass. The three tubes to the right were filled with water that had not been redistilled.

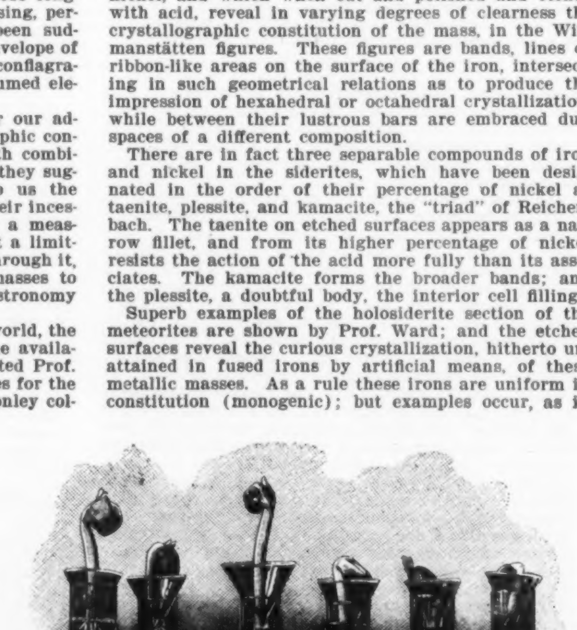


FIG. 2.—The tubes to the left were filled with distilled water that had come into contact with silver, lead, and tin. The tubes to the right were filled with water that had come into contact with copper.

GERMINATION IN DISTILLED WATER.

the Mt. Joy iron, and the Sao Juliao de Moreira from Portugal, where the brecciated character of the surface (polygenic) shows the mass to be made up of irregular iron units, each showing a different etched surface.

Among the very striking specimens in this section may be enumerated, in Prof. Ward's own words (The Ward-Coonley Collection of Meteorites, Chicago, 1901), "the particularly large and choice specimens from Ballinoo and Roebourne (Australia), Costilla Peak, Luis Lopez and Oscuro Mountains (New Mexico), St. Genevieve and Central (Missouri), Oakley and Brenham (Kansas), MacKinney (Texas), and Veramin (Persia). Also a notable and unique iron mass from Central Arabia, fragments of two irons from Patagonia, with larger pieces from Siberia and South Africa."

The larger masses of the Canon Diablo fall are arranged together, and their deeply pitted sides, the tortuous perforations which traverse them, and the curious determination of diamond-like carbon inclosed in them give them a picturesque and scientific interest. Five huge pieces of this famous Arizona-siderite weigh together over a ton. The siderolites, or the mixtures of iron and stony material, are scarcely less interesting. The Brenham, Kansas; Crab Orchard, Tenn.; Eagle Station, Ky.; Imilac, Bolivia; Mincy, Mo.; Veramin, Persia, present the characteristic surfaces of mingled iron and mineral matter, the latter sometimes finely granular, appearing as a black mass speckled with the iron particles, or in other instances both iron and stone equally developed, the iron becoming a cellular body holding in its pits and cavities shining pellets of olivine.

The aerolites, or stone masses, form the larger part of the Ward-Coonley collection, and among them the Farmington, Kansas; Oakley, Kansas; Bluff and MacKinney, Texas; Ness County, Kansas; Homestead, Iowa; Alfianello, Italy, are the more conspicuous by size.

Meteorites furnish two divergent lines of investigation, their morphological structural aspect, and their chemical or mineralogical constitution. In structure meteorites have the brecciated structure, when the surfaces show "angular fragments compressed together and angular fragments imbedded in a ground mass which may have been at one time in a fused or pasty condition" (Farrington). Meteorites are also amorphous, a term applied to structureless stones, and also to "irons" which give on etching no Widmanstätten figures. The iron meteorites generally show a homogeneous crystallized structure produced, according to Sorby, "as the result of such a complete separation of the constituents and perfect crystallization as can occur only when the process takes place slowly and gradually."

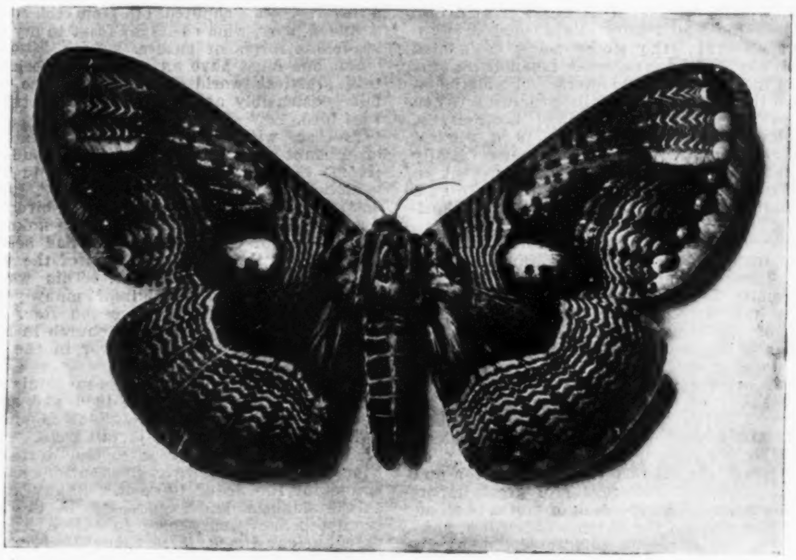
Besides these broader structural characters, meteorites display slickensides, or polished, smooth, lustrous surfaces produced by differential movements in the mass. They are seen in the Long Island, Bath, Mocs, Limerick, Zavid and other masses. Faults, bent plates, veins, cleavage and joints are also observed, and their detection is a significant indication of molecular disturbances within the mass at some time in its history, many doubtless originating in that shortened chapter of their career when they entered our terrestrial atmosphere.

The stone meteorites more generally have chondritic structure, presenting a mass of densely crowded granules which may be glassy crystalline or sinter-like, while again the intimate structure of these chondri may be granular simply, fibrous, or porphyritic.

The mineral composition of meteorites is varied, and while no new elements have been brought to our earth by these wandering children of space, new combinations have been disclosed which do not exist as mineral units on our globe. Such are laurencite, the chloride of iron; daubreelite, a sulphide of chromium; schreibersite and rhabdite, peculiar unions of phosphorus, iron and nickel; osbornite, an apparent sulphide of calcium and titanium, while prevailing ordinary mineral constituents of the stony meteorites are troilite, breunerite, chromite, magnetite, olivine, monticellite, augite, enstatite, anorthite.

The more popular and entertaining aspect of meteorites pertains to their history, the features and peculiarities of their falling upon our earth, and those fortuitous coincidences which collectors relate, and which belong to the chapter of personal associations.

It can be, in conclusion, quite earnestly recommended to all, to whom these "erratics" have been an uncertain and vague reality, to visit and examine this very admirable collection, and learn, from its inspection, to have a more than passing interest in those constantly recurring episodes which mark the entrance upon our world of one of these cometary bolids.



BRAHMÆA CONCHIFERA—ONE OF THE SPECIMENS IN THE SCHAUS COLLECTION.

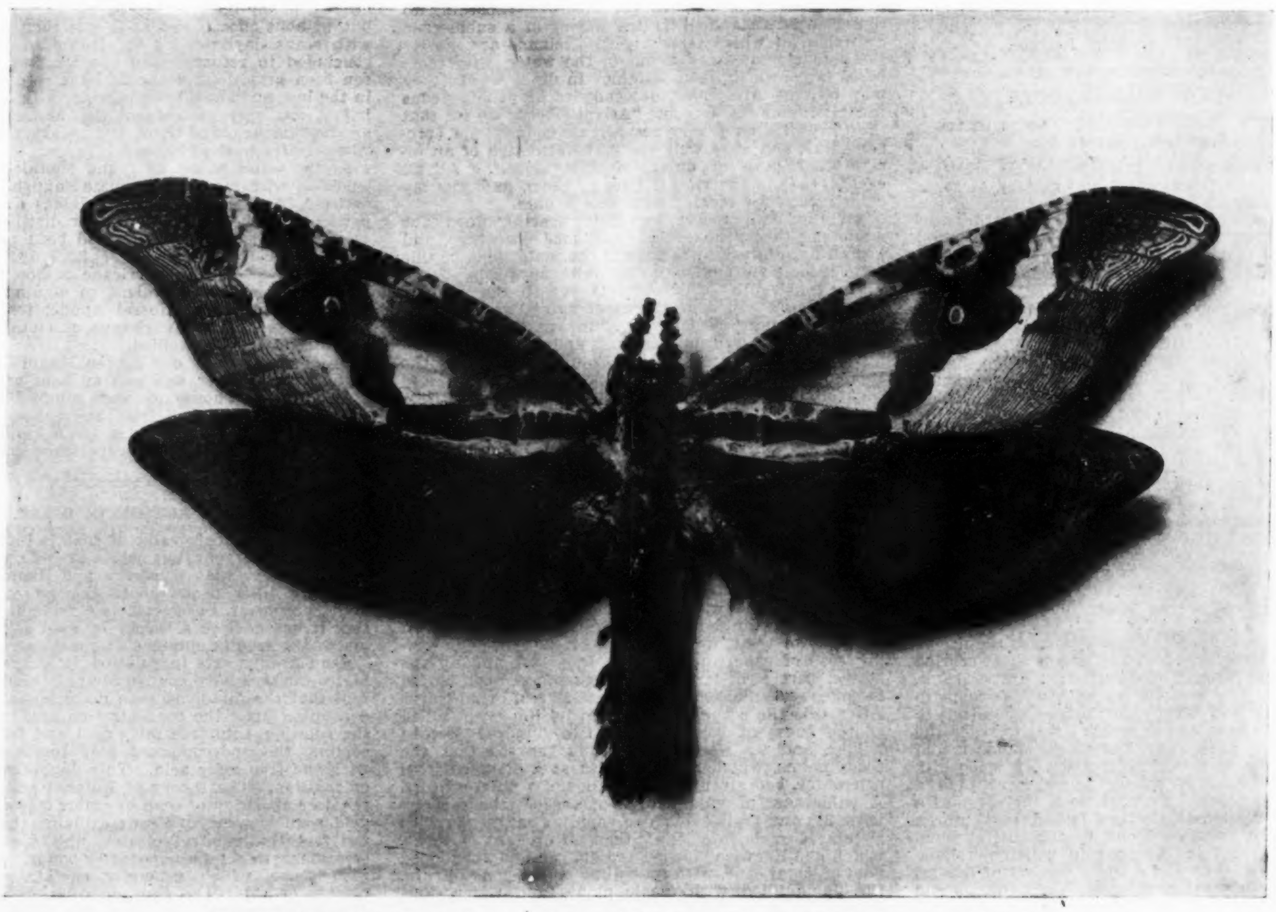
THE SCHAUS COLLECTION OF EXOTIC MOTHS.

THE preservation of the Schaus collection of exotic moths has been assured by the transference of the specimens into new, specially constructed, verminproof cases in the American Museum of Natural History. Inasmuch as other indications of the value of the Schaus collection appear in the article on the development of the entomological department, a few supplementary statements would now seem timely.

The five thousand odd specimens of the collection, representing the principal known genera of Old World moths, were gotten together as a study collection, for comparison with New World forms, by Mr. William Schaus, the describer of many new Lepidoptera, himself an ardent collector, and now the owner of the most complete collection of New World moths in existence.

The study collection of Old World moths was presented by Mr. Schaus in 1897; partly in recognition of the scientific value of the gift, the trustees soon after made the donor a patron of the museum. The collection is especially rich in representatives of the *Bombycidæ* (Spinners), *Noctuidæ* (Owlets), *Geometridæ*, *Hepialidæ*. It contains many type specimens and species authentically determined by comparison with British Museum types. This feature of authenticity makes the collection highly useful to specialists and students, who are further benefited by its accessibility in the American Museum.

As more or less detailed references to the museum collections of moths and butterflies are made from



ZELOTYPIA STACYI—ONE OF THE HEPIALIDS IN THE SCHAUS COLLECTION.

This collection is not the property of the American Museum of Natural History, where it is placed. It is at present simply a deposit, put in its position in the halls of the museum for inspection and study; an exceptional arrangement, applying only to this collection, and accorded to it by reason of its unique character.

time to time in these columns, it may be permissible to indicate briefly the chief characters of the Lepidoptera and the differences between moths and butterflies; perhaps in strictness rather an affair of the text-books.

The members of the order Lepidoptera have four wings, which are membraneous and covered with overlapping scales. The scales are modified hairs. The mouth parts are adapted not for biting, as in primitive insects, but for sucking. The metamorphosis is complete.

The order is often considered as being divided into two sub-orders: the Moths (Heterocera) and the Butterflies (Rhopalocera); the Moths being designated in a general way as the Nocturnal Lepidoptera, the Butterflies as the Diurnal Lepidoptera. The moths on the whole are the less specialized in structure. When at rest most moths hold the wings horizontally, whereas typical butterflies hold them in a vertical position. However, many of the Skippers (family *Hesperidæ*, the most primitive butterflies) present an intermediate condition, in that the forewings are held vertically, while the hind-wings are extended horizontally.

The antennæ of moths are of various forms (whence the term Heterocera), though usually thread-like or feather-like; those of butterflies have (typically) a knobbed extremity (whence the term Rhopalocera).

Most moths have a *frenulum* or bristle attached to the first rib of the hind-wing near the base, which passes through a loop on the under side of the fore-wing, thus assuring the simultaneous action of the fore and hind pairs of wings in flight. In all the butterflies and in the more specialized moths, this device is superseded by the overlapping of the hind-wings by the fore-wings. In both moths and butterflies, as well as in other insect orders, the ribs or veins of the wings are characteristic in number and arrangements. These characters are of great importance in classification. The abdomen of moths is stout, that of butterflies slender, the Skipper butterflies, however, resembling the moths in this respect also. In correlation with the slow, waving flight of most moths and butterflies, the segments of the thorax are not closely consolidated, except in the hawk-moths and others, where the flight is strong and rapid.

The illustration shows one of the Australian hepialids or Swifts. The Swifts (family *Hepialidæ*), and the very minute *Micropterygidæ*, differ from all other moths and butterflies, first, in the great similarity of the fore- and hind-wings, both in form and in the number and arrangement of the veins (an exceedingly primitive feature); second, in the possession of a small lobe or *jugum* on the inner margin of the fore-wing near the base. The jugum extends under the costal margin of the hind wing, while the greater part of the inner margin of the fore-wing overlaps the hind-wing. As does the frenulum of other moths, this device secures the simultaneous action of all four wings in flight. It is, however, a fundamentally different structure; taken in connection with the primitive character of the wings and with the wide geographical separation of the different species of the two families, it is thought to indicate that these genera are the remnants of what was in time past a numerous group, perhaps comparable in number and variety with the butterflies or moths of the present.—W. K. G., in The American Museum Journal.

IN HAUNTS OF WILD PARROTS.

By FREDERICK A. OBER, Author of "Camps in the Caribbees," etc.

THE great "passage-boat," propelled by six stalwart oarsmen, ebony as to complexion and shining of countenance, dipped in and out the numerous bays of the leeward coast, describing a series of curves or scallops. Around the headlands the waves were high, on the beaches the surf was heavy, but naught concerned these sable slaves of the oar, who topped the great rollers with accompanying laughter, and waded through the waist-deep combers with joy.

At last we reached a semicircular bay wedged in between high basaltic cliffs, where vast piles of columnar rocks frowned down upon a crescent-shaped beach of golden sand. On either side they rose, black and gloomy, forming a fine contrast with the shining surface of the beach, warm and bright, crossed by the cool shadows of o'ertopping palms. From the shore a little valley sloped gently toward the eastern hills, which were dotted with clumps of the attractive "groo-groo" palm, and rose steeply to the forest beyond. The vale was filled with sugar-cane, golden like the beach-sands, but of different sheen; in its center the "great house" of a former time, when slaves were numerous and fortunes were the outcome of their labors. It is in ruins now, and also the "works," or sugar mills, for a different cultivation prevails in the island, arrowroot and cassava having taken the place of sugar-cane.

Running the boat upon the beach beneath the drooping palms, the men leapt out, and one of them carried me on his back through the surf to a grassy bank, where a white man greeted me with a "welcome to Cumberland Bay and Westwood Cottage," pointing to a bony steed as the means by which I was to reach the latter. It was a mile away, the estate manager told me, reached by a path that zigzagged up a steep hill, between double rows of stately palms more than a hundred feet in height. Perched upon the crest of a narrow ridge Westwood Cottage looked east into a deep, dark valley, westward out upon beautiful Cumberland Bay. From the veranda in which my hammock was swung there was a sheer descent of several hundred feet into a valley filled with silk-cottons and palms.

The bay beneath was an ever-interesting picture; from the white rim of the surf on the yellow beach the water deepened in color, giving every possible shade of blue and green. Under the cliffs the water was of a light green, and so wonderfully transparent that pebbles, rocks, marine plants and fish could be seen within the depths nearly a mile away. The only movement there, save for the long roll of the sea and the break of the waves, was made by fishing boats in the morning, when the drawing of seines startled schools of fish, which, in turn, drew out the sea-swallows, fish-hawks and pelicans. Except for this, the surface of the beautiful bay was unruffled; at sunset it was a sheet of molten gold, by moonlight a sea of liquid silver, shining white within the encircling masses of the hills. The beach was a perfect crescent, palm-bordered, unbroken in its mile-long sweep, only for the Cumberland River, which cut it in twain.

I had often sighed for some such spot as this:

"Some happy isle, some undiscovered shore;"

and now, during the long period of convalescence from a fever, I was shunted off from the world to this secluded nook, where I might feast to my fill upon the beauteous forms of nature.

But one must have an excuse for seeking solitude; this practical world demands that he should, and mine—ostensibly at least—was the capture of a very rare bird.

And so, without seeking to extenuate my acts—on account of which I am neither proud nor sorry—let me say that my primary object in visiting this island of Saint Vincent in the West Indies was to obtain a complete collection of its birds. I had already found several species hitherto unknown, and in the opinion of the ornithologists had been quite successful; but the largest and one of the rarest of the inland birds had eluded me. This was the great parrot, the Chrysotis Guildingii, many years ago discovered by and named after the Rev. Landsdowne Guilding, one time rector of a church in Kingston, St. Vincent, an enthusiastic follower in the footsteps of White, of Selborne.

Not many specimens have been obtained since the first discovery, for the bird is a shy and wary inhabitant of the "high woods," or mountain forests, living in or near the tops of tall trees. In the Island of Dominica, two degrees to the northward of St. Vincent, I had shot several specimens of the largest species of the genus Chrysotis, known to naturalists as the Augusta, and supposed to be the giant of the family, being twenty-three inches in length.

In ancient times, it is thought, several important islands of the Lesser Antilles, such as Guadeloupe, Dominica, Martinique, Saint Lucia, Saint Vincent and Grenada, had each a different species of Chrysotis living in its forests. In but three of those islands, however, are they found to-day—in Dominica, Saint Lucia and Saint Vincent—though many naturalists, including myself, have hunted for them high and low.

Now these islands are but twenty or thirty miles in length and are separated from each other by sea-channels only twenty miles or so in width, so it is considered as very strange that such large birds as these Chrysotes should have maintained themselves isolate, each in its own island, with specific characteristics unvarying during all the centuries.

Methinks I hear some one query: Forsooth, and what of it?

Well, gentle reader, nothing in particular, except that the scientists have chosen to make a worldwide application of deductions drawn from these individual instances of isolation. Perhaps it were better to say "insulated" individuals—going back to the archaic form derived from *insula*, an island—but no matter. The naturalists, then, have found that these long-time insulated specimens prove (or disprove, according to the scientist's standpoint) the theory of a submerged continent, of which these volcanic islands are merely the pinnacle, sticking up out of the water, with their bases far down in ocean depths. In other words, they may be true Atlantides, descendants of primigeneous inhabitants of the long-lost "Atlantis." So we see that the Chrysotes have very respectable connections (presumably), and were well worth the attention of an insignificant mite of humanity like myself. At all events, that is the view I took of them, and was my chief reason for seeking out their haunts.

All the data respecting their bearing upon the Atlantean theory have been published elsewhere, and I shall not digress further from the main topic of this article, for I am anxious to get into the woods.

The nineteenth of October, 18—(with the reader's permission, I will omit the exact date), was, as I remember, a most glorious day. It was then near the end of the "hurricane season," and the rains were loath to hold up, since old Æolus had allowed the summer to pass without knocking the houses and sugarmills into smithereens—as was his wont. Having given us one day in the week without a downpour, it followed that the tropical clerk-of-the weather considered his duty as more than performed, and at dawn of the twentieth, as I turned out of my hammock, I noted unmistakable signs of a pluvial recrudescence.

But at daylight came "Mannie, the Portugee," the boy I had engaged, a gentle, faithful creature, who, seeing how much I wanted to make the trip, assured me that it might be pleasant. Two months of wrestling with a fever caught by exposure to the rains should have warned me against a venture at this season; but the wish that the weather might clear was father to the thought, and forth we sallied. Down the hill we went, by the winding road, through waving seas of cane, then fording the river and up the steeps, past a little hamlet of thatched huts buried in coffee and calabash trees, plantains and bread-fruits. After this the scene grew wilder, as the river rolled at the bases of basaltic cliffs two hundred feet in height, and we were so far from the sea that the cocoa palms, which never flourish at a distance from salt water, had given place to palms of a different sort. A wilderness of wild guavas succeeded, the scrubby trees bearing fruit enough to supply a multitude with sweets, if made into jelly; then an orchard of limes, which had likewise "turned Indian," and an abandoned field of sugar-cane, with its boiling works gone to ruin, the flume filled with tropic plants and water-wheel broken.

By a steep and narrow path, wending its way along the brink of precipices and crumbling embankments, we again descended to the river, and on its further bank found a small thatched hut with wattled walls, which had been built by Mannie's father as his "watch-house," being adjacent to his "provision grounds" in the hills.

As the rain came down just then in torrents, we were glad enough to avail of its shelter, and my guide unlocked the door, which was secured by a rusty padlock, and threw it open. As I dove within, he threw my poncho over the horse and saddle, then made a fire and boiled some coffee, and set forth our breakfast of cold boiled plantains, bread-fruit and goat meat. Father and son were great woodsmen, and the hut bore various evidences of their skill, in the various contrivances for comfort and use that a wood life teaches. There were nets of bark and lines of twisted grass for securing the fish in the river, traps for wild pigeons and agoutis, and baskets many for holding the vegetables from their provision grounds. As Mannie's two sisters often came here with him and his father, the greater portion of the interior, at the best restricted, was taken up with two wattled platforms of poles and lianas used as beds.

Rains cannot last forever (though they come quite near doing so, it used to seem to me, in the tropics), and after an hour or so of waiting there was a brief cessation of the deluge, which we improved to make a break for the mountain ridge. The slope was too steep for the horse to climb, so I followed after the boy on foot, my heart fiercely palpitating from the exertion, and stopping every two or three minutes to take breath. The trees had been growing larger and mightier, the undergrowth more scanty, and at last we reached that distinctive section of the forest known as the "high-woods." Had I been dropped here without knowing where I was I should have recognized the region I was in from its characteristic trees, and should have said, also, that I was then in the home of the wild parrot. A narrow, knife like ridge of rock, thinly covered with humus, supported a growth of great trees, all giants in girth and height, such as the "gommier," "bois blanc" and "bois diable," with groves of tree ferns and mountain palms.

A delightful perfume filled the air, probably washed down from the vine-covered trees, and it was a pleasure to be in such a spot, even though showers fell heavily at intervals. It was owing to the rains, Mannie said, that the parrots, usually so vociferous, were now silent, and instead of seeking food, flying noisily from place to place, they were sitting quietly upon the topmost limb of some tall tree, far out of sight and shot. It is their habit, when the sun comes out, to salute it with loud cries; but the sun did not appear at all this day, and so they did not salute. By closely scrutinizing all the trees about me, I at last located a brace of parrots in the very top of an immense gommier, so far away that it was impossible for me to tell until one of them moved whether they were birds or merely a bunch of leaves. I fired at a venture, and missed them both; but the report of my gun started out a flock of a dozen or more, which flew with a great noise toward the depths of a ravine, whither I sent Mannie in pursuit.

I should have gone myself, but a ton or two of water came falling, from the skies, just at that time, and instead I sought a shelter under the lee side of a great tree. Good cause had I for regretting my laziness, for about half an hour after I heard the report of his gun Mannie appeared, holding the bedraggled semblance of a parrot, which was minus most of its feathers, including the tail, from the combined effects of moulting, the rain, and an overcharge of powder.

Honest Mannie deplored, and I lamented; but what use? The boy imitated the parrot's cries to perfection, but without effect; and as it was then mid-afternoon, with scant daylight for the tramp to Westwood, we concluded to return. Had the weather and the season been propitious, I should have camped that night in the hut, and sought the parrots early next morning; but it was only too evident that the rain gods were on the rampage, and there was no knowing when they would retire to their caves.

At the watch-house we found Mannie's father, who condoled with me in Portuguese-English, the while he assisted in disposing of the eatables and drinkables, particularly the "shrub," a liquor distilled from cane-juice with limes, and which had been given me by a generous planter.

Getting wet in the hurricane season is considered by the creoles as equivalent to signing one's death-warrant; but by a liberal application of rum externally, and a prompt change of clothing, all dread consequences were avoided.

From the trees in our garden Mannie had procured material for supper, and half an hour after starting a fire in the cook-house we were sipping chocolate and eating bread-fruit hot from the ashes. And, sooth, there are many worse things for a hungry man than roasted bread-fruit, as my experience goes to show.—The Independent.

THE ACTION OF SOAP.

THE high hygienic value of soap is instinctively recognized by everyone, but people are as a rule contented with the fact that it cleans and disinfects without troubling their heads about the reason. The soapmaker, however, recognizes as a triumph of chemistry that it has devised a theory of soap action which explains the results obtained in practice.

Soap always acts in solution in water. Krafft and his co-workers have confirmed the conclusion of Chevreul that the dissolved soap decomposes, to an extent depending upon the concentration and temperature of the solution, into free fatty acid and free alkali. On cooling, the undecomposed soap forms a double salt with the free fatty acid. This double salt is difficult of solution. The theory of Rotondi and Fricke as to the decomposition of soap by water into a basic and an acid soap is wrong. Krafft explains their results by the fact that neutral oleates, unlike palmitates and stearates, are not decomposed by water. Hence in common soaps, which generally contain all the three classes of salts, the aqueous solution would give a mixture of neutral oleate and free alkali. This might be mistaken for a basic soap, and the double salt above mentioned for an acid soap.

In washing with soap four factors co-operate, the free alkali, the free fatty acid, the neutral undecomposed soap, and the acid double salt formed by the reaction of some of the latter with some of the free fatty acid. If we understand by washing the emulsification of the fats which everywhere in nature are the cause of the clinging of dirt, and the removal of it in combination, we contemplate a result which can

be obtained perfectly well with soap and water and elbow-grease. The great soaking power of the soap, which is perhaps attributable to traces of freed alkali, enables it to drive all air from the recesses of the fabric, and to come into intimate contact with the dirt. The undecomposed soap emulsifies the fat, and the double salt then incloses the solid particles of dirt set free from the fat, and carries them away when the rinsing is done. The alkali set free, which is only small in amount, plays a subordinate part, and by no means that which is often assigned to it. In very dilute solution its action may be neglected. Only in such solutions is there much set free, and the dilution keeps pace with the increase in the amount of alkali set free. Besides the emulsion tones down the action of the free alkali on the fiber, and in combination with the fused fatty acid diminish the amount of rubbing required, and thereby conduce greatly to the longevity of the articles washed.

As Quincke has shown, however, the physical side of the action of soap is of great importance. That chemist has proved that osmotic action causes vortices which loosen the dirt and save rubbing, and tend to preserve the lather. These vortices are largely due to the decomposition of the soap in aqueous solution.

Jevons' soap theory is related to Quincke's vortex-hypothesis. Jevons asserts that the soap particles in water have much "pedesis"—i. e., rush vigorously about and push the dirt off the linen. This theory is only mentioned here as an illustration of the tendency to explain the action of soap on mechanical grounds.—Seifensieder Zeitung.

[Continued from SUPPLEMENT, No. 1333, page 21369.]

THE FIRE HAZARD OF THE MORE IMPORTANT CHEMICAL PRODUCTS.*

By ERNEST H. COOK, D.Sc., F.I.C., F.C.S.

CLASS 3.—BENZINE AND ALLIED BODIES.

THE third class into which I have ventured to divide the principal chemical manufactures includes what may be called the coal tar products.

In the process of gas-making there is formed in the "hydraulic main"—a large pipe partly filled with water, through which the gas passes immediately after leaving the retorts—two liquids, one, the lighter, containing a large quantity of ammoniacal compounds, and hence called "ammoniacal liquor," and the other what is known as "coal tar." The ammoniacal liquor is sold to the ammonium salts-maker, and forms the principal source of all our ammonium compounds. The tar is usually treated in separate works by distillation, and a series of products are obtained. From these, by subsequent treatment, many important commercial substances are formed, among these being the following: benzine and chemically similar bodies, carbolic acid, naphthaline, anthracine, and pitch, and then by further treatment we get aniline and the beautiful series of well-known aniline dyes. Owing to the magnitude of this branch of trade, the various processes here mentioned are frequently subdivided, and the first rough distillation of coal tar forms a distinct branch by itself. The products which the tar distiller makes are obtained by dividing the distillate into various fractions. Commencing at that which distills over first, we get "ammoniacal liquor," "first light oils," "second light oils," "creosote oils," and "anthracine oils" in the order named; while pitch remains behind in the still. An ordinary size for a still is one holding 1,200 gallons of tar. It is made of iron and heated by a fire underneath. Of course the whole of the products and the substances used are combustible, and hence great care should be taken to regulate the fire to prevent boiling over, as well as arrangements for charging and discharging the still. For instance, the still should be fairly near the tar tank, and the supply pipe should be on the opposite side of the furnace door, so that in case of a pipe breaking there should be time to damp out the fires before the issuing vapors reach the furnace. Also the cock for withdrawing the liquid pitch should be at the opposite side of the fire door, so as to avoid the chance of ignition while running out the hot mass into the pitch tank.

The light oils are used for the manufacture of benzine or benzol, toluine, and carbolic acid. For this purpose they are first treated with sulphuric acid in lead-lined tanks, then with water, and finally with milk of lime. The carbolic acid is thus separated, and then the benzine and toluine are distilled off by steam.

From benzine and toluine several products are made, the most important perhaps being nitro-benzine and aniline. For the former a mixture of sulphuric and nitric acids is made to act upon benzine. Great heat is produced, and a large quantity of nitrous fumes (oxides of nitrogen) are given off. The product is washed with lime water, and then water alone, and then distilled by steam. If pure benzine has been used, and care taken in the manufacture, the product forms what is known as "essence of mirbane"—a pure form of nitro-benzine used in perfumery and for flavoring purposes.

Aniline is made from this nitro-benzine by acting upon it with a mixture of acetic acid and iron. From this mixture hydrogen is produced, and this attacking the nitro-benzine converts it into aniline.

Frequently aniline makers are also nitro-benzine makers, and, as will be at once understood, the processes are extremely dangerous. The storage of the "light oils," or naphtha, requires great care. The vats or casks should be kept very cool and away from the stills and mixing vessels, which are apt to become hot by the chemical changes which go on in them. If required to be visited by lights, only safety lamps should be employed. Then, also, the strong acids required should be looked after, and kept away from woodwork as much as possible.

The numerous aniline dyes are made from aniline by the action of different chemical substances. Thus, oxidizing agents, such as arsenic acid or lead nitrate, produce magenta or rose aniline, which gives rise to a large number of other colors.

The creosote oils produced by the distillation of coal tar are used for pickling timber, and for making certain kinds of disinfectants. Timber thus treated would be somewhat more combustible than in the ordinary state.

The most valuable portion of the coal-tar distillate is the anthracine, because of the use which is now made of it to manufacture madder colors. A crude product is obtained by simply allowing the anthracine oils to stand, when the solid portions, chiefly consisting of anthracine and naphthaline, separate and are removed by filtering through coarse sackcloth, and afterward pressed by hydraulic pressure. This crude product varies in quality from 30 to 60 per cent anthracine. It is sold by the coal-tar distillers to the anthracine refiners, who purify it by hot pressing and treatment with light petroleum. Finally it is passed to the color makers, who convert it either into "anthraquinone" by oxidation with either nitric acid, or sulphuric and potassium bichromate; or into "chloranthracine." From these substances the dyes "alizarin" and "purpurin" are obtained. So important has the manufacture of these dyes now become that the growth of madder, the basis of Turkey red dyes, has been almost discontinued, and thus thousands of acres of valuable land are rendered available for the growth of cereals.

The processes of manufacture are liable to the risks of fire already pointed out—viz., those connected with the storage of strong acids and alkalies and chemicals which are powerful oxidizers. There are not so many volatile and inflammable substances, however, in use, and hence the color-making with aniline is not so dangerous. This, however, is not the case with anthracine refining, which employs petroleum oils, and is best done in a separate building.

The process of dyeing consists in fixing the colored substance upon the fiber in such a way that it will not easily rub or wash off. In the great majority of cases the colors have no power of combining with the fiber of themselves, but have to be fixed by means of substances called "mordants." These are of various kinds, but all consist of chemical substances which have the power of forming with the color an insoluble compound which is precipitated within the fiber. In some cases the methods adopted have led to conflagrations of a serious character. Thus, the too rapid drying or storing of goods dyed with Turkey red has frequently led to fires. The heat of the stoves should be carefully regulated, and the temperature of the materials watched. Probably the cause leading to these fires is that of oxidation of the size, grease, oil or other substance with which the warps are treated. For some colors the "fixing" has to be done by a process of oxidation, and the introduction of salts to bring this about is attended with considerable risk in the subsequent drying unless great care is taken. The temperature of the drying room should be watched and kept as low as possible, even although this involves a loss of time in passing the goods through.

CLASS 4.—PAINTS, VARNISHES AND SIMILAR BODIES.

Generally speaking, the basis of paints is, or ought to be, white lead. With this is mixed the colored substance until the required tint is obtained. As white lead is incombustible and usually the colored substance is a mineral color, and, therefore, also of the same nature, it seems that color works would be a good risk; but the plan of making the materials with oil, and of sometimes grinding them in it, opens up at once the whole of the dangers connected with that substance. The liability of the vegetable and animal oils to undergo spontaneous oxidation is well known and has oftentimes been extensively written upon. This phase of the risk, being present whether the oil is chemically treated or not, does not come into our present inquiry. But for the use of the paint manufacturer the oil is generally treated, and a word or two is necessary in regard to this treatment. The object of mixing the colored substance with oil is to afford a medium for spreading it over a surface, but it is essential that the oil should dry quickly. This it would not do in its natural state. The oil is therefore "boiled." This so-called boiling, for it is really not boiling at all, is brought about by heating in an iron boiler with constant stirring. The oil rapidly darkens in color, becomes thicker, and inflammable gases are given off. These are sometimes purposely ignited at the top in order to darken the substance more quickly. Linseed oil thus treated is much more readily oxidized when spread out in a thin layer and exposed to the air. This oxidation constitutes the drying. In order to still further increase the rapidity with which this takes place, certain chemicals are sometimes mixed with the oil. These are called "driers," and among the substances used for this purpose are—litharge (oxide of lead), red-lead (another oxide of lead), acetate of lead, binoxide of manganese, sulphate of zinc, etc. The addition of these substances, while bringing about the required drying properties, at the same time adds to the possibility of ignition under suitable conditions in consequence of spontaneous combustion.

But there are other risks attendant on paint-making which, although of less importance than those due to oil, are yet present, and as they are somewhat obscure they may possibly be overlooked. These arise from the paints, i. e., the coloring matters themselves.

"Lamp black" is made by burning resin, bone oil, or coal tar, and collecting the smoke in a suitable chamber or in bags. The substance is afterward partly purified by calcining in iron cylinders. This gets rid of some of the oil or grease, which would otherwise hinder the drying of the paint. But there is frequently a little oil left in, and this small quantity is quite enough to cause, by its oxidation, spontaneous ignition. It is the case of oily waste over again, and several fires have been traced to this cause. The storage of this substance should, therefore, be very carefully considered and precautions taken against contact with inflammable material and woodwork. It should also be borne in mind that a small quantity of water, such, for example, as would be met with in a damp store-room, would act as an aid to oxidation.

The peculiarities of madder colors have already been mentioned. Since they are also used as pigments, the same precautions are necessary with regard to them.

A favorite and very beautiful yellow paint is the chromate of lead, which may be taken as a type of the "chromes." These substances are made from the potassium chromates, bodies which in their turn are made from chrome iron-ore. Both the chromate of potassium and the dichromate are salts which are very rich in oxygen, and they should therefore be kept away from possible admixture with warm combustible substances. The orange yellow chromate of lead is obtained by adding a solution of chromate of potassium to one of nitrate of lead. It also contains a good deal of oxygen, and both it and the nitrate of lead from which it is made must be carefully stored. In fact, it may be briefly stated that all the chromates are highly oxidized bodies and should be treated accordingly. Several substances used as brown pigments are combustible. Thus asphaltum or bitumen, originally a mineral product, but now obtained as a by-product in the manufacture of coal gas, is used to a limited extent; mummy, another kind of bitumen obtained from the catacombs; sepia and its varieties are combustible; while the first-named when dissolved in turpentine is highly inflammable.

Of the blacks, in addition to lamp black already mentioned, there is ivory black, made by carefully calcining bones; or, very rarely, ivory. This should be carefully looked after, as it is open to the same objections as lamp black, and is probably even more dangerous. These blacks are used in large quantity for the manufacture of printers' ink and blacking, hence precautions ought to be taken in these establishments in regard to them.

Some greens are made by mixing chrome yellow with Prussian blue. Now, the latter substance is a compound of iron with carbonaceous matter, and hence would burn at the expense of the oxygen in the chromate. A destructive fire arising from this very cause is on record, and hence such greens ought to be carefully watched.

VARNISH.

A varnish may be regarded as a fluid which, when spread out on a surface, dries to a film which possesses a certain amount of luster and is impervious to air and moisture. The simplest kind of varnish is that of the solution of some sort of resin or gum in a volatile liquid; but an oil varnish is one which contains an oil in addition to these substances. "Spirit" varnishes—i. e., those of the first class—are the quickest driers, but they are liable to crack; and the addition of the oil, although making them take longer to dry, generally makes them more durable and lustrous.

Several substances are used as solvents—such as methylated spirit, naphtha, turpentine, and, for some of the very high-class ones, ether and chloroform.

The oil most frequently employed is linseed, but sometimes walnut and poppy oils are used.

The "gums" are usually anime, amber, copals of various kinds, shellac, resin and asphaltum.

The gums are melted and mixed with the heated oil. During this process inflammable vapors are given off, and the whole process is highly dangerous. Before use the oil is generally clarified, and driers are almost always added.

"Japanning" is a form of varnishing in which the end process requires heat. The manufacture should be carried on preferably in a separate building, but at any rate in one where the vapors can be rapidly carried away, and where the pots, if they catch fire, can be rapidly wheeled outside into the open.

CLASS 5.—EXPLOSIVES.

As a rule, I presume, insurance companies are not very anxious to accept the risks of explosive factories, nor even of any building in which they are stored in large quantities; therefore, very little need be said in regard to this branch of chemical manufacture. It is necessary to remember that explosives can be divided into two easily defined classes—first, those which consist of mixtures; and, secondly, those which are chemical compounds. The first class consists of substances very intimately mixed together, one or more of which are bodies very rich in oxygen—such as nitrates or chlorates of potassium or sodium; the other material or materials being such as can form compounds with oxygen which are gaseous.

The typical substance of this class is gunpowder—a mixture of niter, charcoal and sulphur. When ignited the oxygen of the niter combines with the carbon to form carbon dioxide or carbonic acid gas, and with the sulphur to form sulphur dioxide. Both these substances are gases, and at the temperature at which the ignition takes place are enormously expanded; hence the force of the explosion.

The second class consists of what are known as "high explosives"—such as dynamite, guncotton, etc. These consist of chemical compounds of the oxygen-containing body with the combustible, and since in a chemical compound the substances are much more intimately connected than in the most carefully made mixture, the force of the explosion is usually greater.

In most of these bodies the substance containing the oxygen, that is, the active body, is nitric acid or chloric acid.

Thus nitro-glycerine, which is used in making dynamite, is made by acting upon glycerine with the strongest nitric acid, strong sulphuric acid being used at the same time so as to keep the nitric at full strength during the action. Guncotton is nitro-cellulose prepared in a similar way, but using cotton instead of glycerine. Picric acid is made by the action of nitric acid upon carbolic acid. It is of a fine yellow color and is sometimes used in dyeing; therefore, it should be looked out for in dye-works, as it is a dangerous substance. As an explosive it has not quite enough oxygen, and hence it is sometimes mixed with nitrate or with chlorate of potassium. Melinite is said to be simply compressed picric acid; and mixtures of various kinds are in use under fancy names. These high explosives are fired by concussion or compression, usually brought about by the action of another explosive—fulminate of mercury, which is used in percussion caps.

CLASS 6.—OTHER CHEMICAL SUBSTANCES.

Under this head would be included a very large

* Extracts from a paper read before the Bristol (England) Insurance Institute.—From Insurance Engineering.

number of substances not falling into any of the former classes. Only a few of these can be noticed.

Acetic acid is prepared by the dry distillation of wood. In this way several different substances are obtained; some in the brown watery fluid obtained in the receiver, some left behind in the retort. The fluid in the receiver which contains the acetic acid is first distilled with lime, when the "wood-spirit" and "acetone," two of the substances, are separated, and the acetic acid, combined with the lime as calcium acetate, remains behind in solution. This is evaporated, when tarry matter rises to the surface and is removed. The calcium acetate is then decomposed by sulphuric acid, which combines with the lime and sets free the acetic acid which is obtained from the mixture by distillation. During the manufacture inflammable vapors are given off, and care should be taken in surveying to see that the arrangements for storage, not only for the acid, but also for the lime, tar, wood-spirit, and acetone produced or used in the process, are satisfactory.

Acetic acid is used in making paints, varnishes and white lead; also in treating caoutchouc, gums, etc., and for making acetates for use in dyeing.

Alum is made on a large scale for use in dyeing, from "alum shale." This is a kind of clay-slate rock, containing iron pyrites and bituminous matter. This mineral contains the iron pyrites in a very finely divided state, and hence when exposed to air and moisture this substance rapidly oxidizes, and sulphate of iron is formed. Great heat is given out by the spontaneous oxidation. This acts on the iron sulphate in the same way as if it were roasted, and the sulphuric acid is expelled and attacks the alumina in the clay, forming aluminium sulphate. After lixiviation and separation of impurities, potassium chloride or sulphate, or ammonium sulphate, is added and the mass crystallized. In connection with this manufacture it must always be remembered that the "alum clays" or "aluminous schists," from which the alum is made, are liable to spontaneous combustion. Manufactured alum is not combustible.

Ammonium compounds are made from the ammoniacal liquor which is made in such large quantities in gas works. They are not of themselves combustible, nor does the manufacture afford points of interest. But I find a statement in a paper, called the Fireman, saying that the ammoniacal liquor is very good for putting out fires, and has been successfully used for that purpose. If this is the case, one pities the poor firemen, as the ammonia given off from the liquid renders the odor of it intolerable.

In the manufacture of soap various kinds of oils and fats are boiled with caustic soda. Almost any kind of fat can be used for this purpose and, therefore, the risks of ignition due to spontaneous oxidation of the oils are always present. There is also a danger in some works of a boiling-over taking place. The arrangements of the fires under the boilers should, therefore, be carefully looked after. A large number of soap boilers make their own caustic soda. This is done in the same way as in alkali works, and the remarks made in regard to those apply, so far as caustic soda is concerned, to these. Before being sold the cakes of soap are kept in a room to dry. This is sometimes warmed artificially, and of course the woodwork becomes very dry after a few years.

Before using the oils or fats the soap maker and candle maker generally bleach them. This is done in different ways, the principle being that the coloring matter shall be acted on by oxygen and rendered colorless. Mixtures of strong sulphuric acid and bichromate of potassium, or of sulphuric acid and binoxide of manganese, or hydrochloric acid and binoxide of manganese, or hydrochloric acid and bichromate of potassium are frequently employed. Of course, a good deal of heat is caused by this action, and the whole process is one requiring the careful attention of the insurance surveyor.

In the manufacture of glass and porcelain there are very few fire risks, except those of the furnaces, which are intensely hot, but which are usually carefully protected. For some of the operations, however, oxidizing substances, such as oxide of manganese, niter, etc., are required. The storage of these must be regulated with the same care as that used in alkali works for the same substances.

The last manufacture that can be referred to is that of "artificial manures." These are made by treating some insoluble natural substance in such a way that it may become soluble in water, and thus available for the use of the plant. Generally, insoluble phosphate of lime is made into what is called "superphosphate" by the action of strong sulphuric acid. Bones are also treated with this substance, and thus made more quickly available for the plants when dug into the soil.

The process itself is not one involving many risks, except that a large amount of strong acid is required to be stored, and the precautions for storage before mentioned should be taken in these works also. Sometimes the material treated with the acid is impure, and contains a large quantity of water and organic matter. In such cases enormous heat is evolved by the treatment, and the product is liable to become hot spontaneously if improperly stored. Since it is very difficult to distinguish this product, except by analysis, from a good sample, it is well to fix a rate for the dangerous substance, which would then cover the whole.

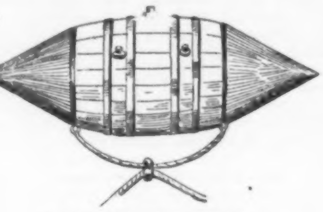
SUBMARINE MINES.

THE term submarine mine is applied to a closed receptacle, containing a strong charge of an explosive material capable of being submerged, and so arranged that it may burst either on contact with a submarine or floating obstacle so as to destroy it, or in the vicinity of the live works of a ship, so as to sink the latter.

The submarine mine is stationary. It is called also a submerged mine chamber, and stationary, dormant or anchored torpedo. It is especially designed for the defense of coasts, ports and channels.

It was Bushnell, an American, the inventor of one of the first submarine boats, who, in 1777, made the first experiments relative to submarine mines. The object of these was to prove that powder could detonate under water, and they succeeded perfectly. His mine consisted of a charge of powder contained in a wooden flask placed in a barrel having strengthened staves. A wooden tube penetrating as far as to the charge permitted of priming, and the firing was done at the desired moment by means of a trigger.

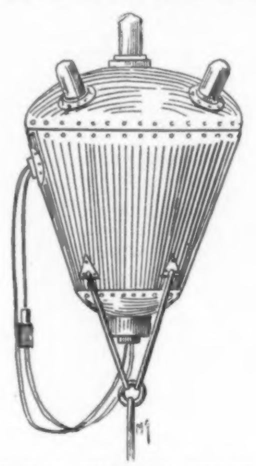
Twenty years later Fulton blew up a brig with a



BARREL TORPEDO.

submarine mine containing 180 pounds of powder, which he ignited by means of a clockwork movement.

These experiments of the two celebrated inventors fell into desuetude, and submarine mines were not mentioned again until 1854, during the Crimean War. The canals in the vicinity of Cronstadt were filled with apparatus consisting of hollow iron vessels of conical form containing a charge of powder at the upper part, while the lower part formed an air chamber. They floated point downward at 10 or 15 feet below the sur-



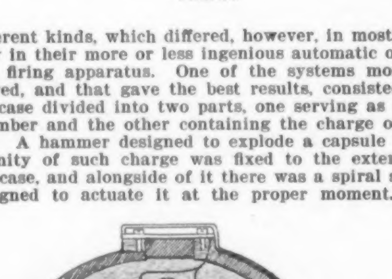
RUSSIAN CONICAL TORPEDO.

face of the water and were anchored to the bottom of the sea. A small glass tube filled with sulphuric acid and broken by a shock upon the passage of a ship allowed the liquid to flow through a flexible tube over sugar imbedded in chlorate of potash. The chemical reaction that immediately occurred caused the ignition of the powder.

The Americans made very frequent use of the submarine mine, which they had improved, during the War of the Rebellion. There were quite a number of

RUSSIAN CONICAL TORPEDO—INTERIOR VIEW.

different kinds, which differed, however, in most cases, only in their more or less ingenious automatic or electric firing apparatus. One of the systems most employed, and that gave the best results, consisted of a tin case divided into two parts, one serving as an air chamber and the other containing the charge of powder. A hammer designed to explode a capsule in the vicinity of such charge was fixed to the exterior of the case, and alongside of it there was a spiral spring, designed to actuate it at the proper moment. The



ELECTRIC DORMANT TORPEDO.

hammer was kept cocked and the spring taut by a pin to which a float was attached by means of a cord. The system was so arranged that the pin could fall when a boat touched the cord or the float. The hammer when released fell upon the capsule and caused an explosion.

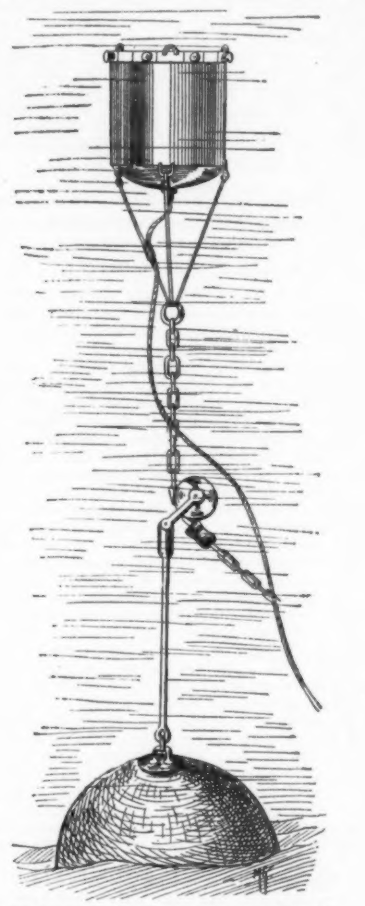
A large number of ships were destroyed during the course of this war through the effect of the explosion of submarine mines.

Submarine mines may be divided into two categories: Dormant torpedoes, which rest directly upon the bottom of the sea, and anchored torpedoes, which are held at a certain distance beneath the surface by some system or other of mooring.

We shall not speak here of the explosion chambers that are designed to destroy obstacles such as rocks, the hulls of wrecked ships, etc.

The dormant torpedo is placed only at points in the sea where the water is not very deep. Beyond a certain depth it takes enormous charges to obtain a dangerous circle of 25 feet radius at the surface. It is this kind of torpedo that contains the strongest charge of explosive. Some have been constructed that contained as many as 4,400 pounds of powder.

The anchored torpedo is generally placed at 10 or 15 feet beneath the surface. In order to render it the more easily manipulated, it is charged in most cases with but from 35 to 45 pounds of explosive. It pro-

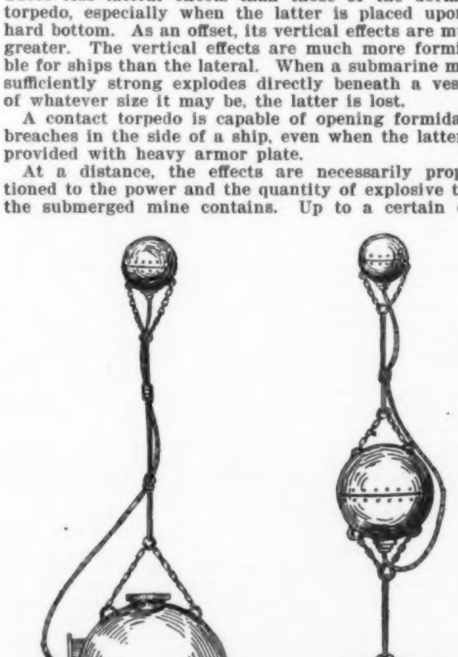


AUSTRIAN ANCHORED TORPEDO.

duces less lateral effects than those of the dormant torpedo, especially when the latter is placed upon a hard bottom. As an offset, its vertical effects are much greater. The vertical effects are much more formidable for ships than the lateral. When a submarine mine sufficiently strong explodes directly beneath a vessel, of whatever size it may be, the latter is lost.

A contact torpedo is capable of opening formidable breaches in the side of a ship, even when the latter is provided with heavy armor plate.

At a distance, the effects are necessarily proportioned to the power and the quantity of explosive that the submerged mine contains. Up to a certain dis-



Dormant Torpedo. Anchored Torpedo.

TORPEDOES AND THEIR FLOAT.

tance from the center of explosion the back wave forms a breach in submerged bodies, but beyond such zone and up to other limits it crushes them or does them serious damage.

Considered from the standpoint of the diversity of

the modes of firing, submarine mines may be divided into three classes: Automatic, electric and mixed.

The ignition of the first can be effected only under the influence of a shock or of a pressure against the torpedo itself, or against its float, that brings about the explosion of a percussion cap or a chemical reaction disengaging enough heat to ignite the charge. This is a very simple process that dispenses with the complication of conductors of electricity and posts of observation necessitated by electric firing. Unfortunately, however, it presents certain inconveniences. The mines must be very close together in order that a channel may be efficiently protected, and it is therefore necessary to employ a large number of them. It is somewhat difficult to keep track of their condition, and they may explode on contact with a floating body carried along accidentally by the tide or launched by the enemy. They are a perpetual menace to friendly or neutral vessels that ply the waters that it is desired to defend. The percussion apparatus that they require are very costly; the springs rapidly lose their power; and shells and herbage quickly render the delicate parts of the hammer inefficient. Finally, their anchorage place is easily detected, and dragging for them by the enemy is not difficult. For all these reasons, the automatic system is not now employed, and preference is given to electric firing, which is done through a spark or through the interposition, between the extremities of the conductors, of a primer that the current heats and ignites.

The electric firing is simple when it can be effected only at the will of the operator. The latter observes the motions of the enemy's ship, by means of a spyglass, and when he sees that it is directly over a submerged mine, he presses upon a commutator and causes an explosion. But such an observation cannot always be made with precision, and it often happens that the mine explodes while the ship is out of range of it. Moreover, this system demands the concurrence of a large number of manipulators, the irreproachable operation of very delicate members, and, on the part of the observer, an unremitting attention that soon becomes fatiguing. Finally the execution of it becomes impossible in the case of a dense fog or when the enemy's ship is enveloped in smoke. So the electro-automatic or mixed firing is often substituted for it. This embraces the use of a double interruption commutator.

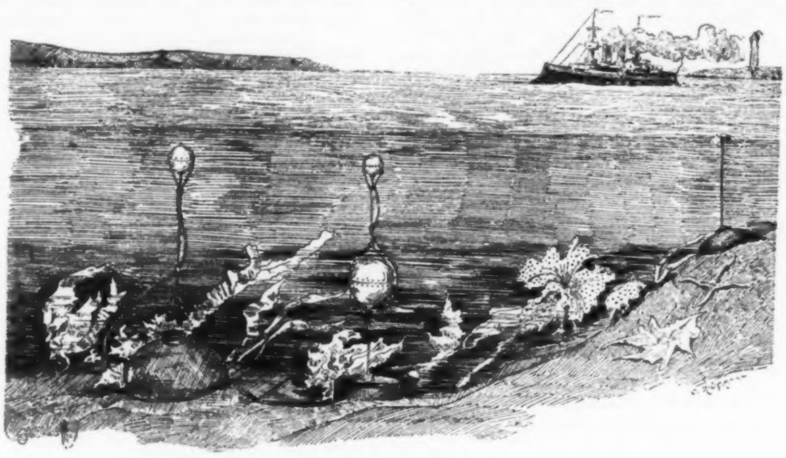
The electric circuit is interrupted at the post where the operator is situated and where the wires end, and in the torpedo itself. The electricity can therefore produce the ignition only at the precise moment at which it is closed by the shock of the torpedo or of its float against the ship's side.

Mixed torpedoes offer indisputable advantages over the preceding, since it is possible, at will, by interrupting or re-establishing the circuit to deprive them of or communicate to them their explosive properties. Their only inconvenience is that they require the use of apparatus that are quite delicate and subject to deterioration.

Submerged electro-automatic torpedoes are the ones of which the use is preferable to that of any other. They are adapted for all depths and operate just as well at night as in the daytime. They are arranged in lines, each formed of two quincuncial rows with intervals of 98 to 130 feet for charges of 65 pounds of guncotton. The torpedoes are grouped by sevens on each line. The conducting wires of the same group end at a central junction box laid upon the bottom and communicating with the firing post through a cable.

Submarine mines are placed in straight lines or curves in channels or offings or along the coasts to be defended.

As it is generally indispensable to carry the line of submarine defense quite far out to sea in order that the enemy's ships cannot approach sufficiently near to bombard the port or coast, such line must necessarily have a great extent. Since, on another hand, a submarine mine has quite a limited dangerous radius, it is necessary, in order that the defense shall be efficacious, that the mines shall be quite near each other. It follows that the number to be placed is very large, and the establishment of a line (upon points carefully marked in order to prevent the worst accidents) is a difficult operation that it takes long to perform and that necessitates the expenditure of a large amount of money.—Le Monde Moderne.



Dormant Torpedo. Anchored Torpedo.

TORPEDOES IN SITU.

Victorian Gold Jubilee.—Under date of May 28, 1901, Consul-General Guenther, of Frankfort, reports: The government of Victoria intends to hold a national and international exposition in the district of Bendigo, to commemorate the discovery of the gold fields in 1851. All branches of the arts and sciences, the industries, inventions, etc., will be represented.

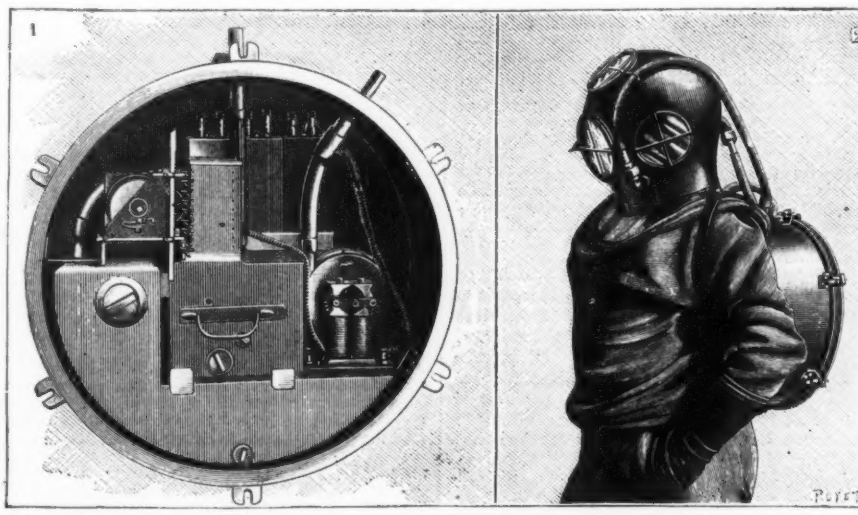
REGENERATION OF VITIATED AIR.

LAST year Messrs. Desgrez and Balthazard called attention to a chemical substance that is used in dyeing and possesses the property of becoming decomposed in contact with water and forming oxygen and soda. This substance is binoxide of sodium. In the laboratory of Prof. Bouchard, at the Faculty of Medicine, they succeeded in making animals live in a close vessel for hours by regenerating the exhausted air through the intermedium of this chemical, and demonstrated in this way that, in a hermetically closed medium, binoxide of sodium, thrown in small quantities into water, disengages sufficient oxygen for respiration, while the soda that is simultaneously formed fixes the carbonic acid of the air expired. At the same time, there is a destruction, through oxidation, of the toxines contained in the gas that makes its exit from the lungs.

This method of regenerating air is evidently applicable to a person breathing in a close space. Messrs. Desgrez and Balthazard have succeeded in devising a practical apparatus that will permit henceforward of living in an irrespirable medium—in mephitic gases as well as in water. It is unnecessary to say that this problem was solved a long time ago by means of the diving dress. An air bag, also, carried upon the shoulder, with flexible tubes coming within reach of the respiratory tracts, permits of entering wells that disengage carbonic acid or places filled with smoke. But in all the systems known, when it is desired to remain at least an hour in a vitiated atmosphere, it is necessary to employ a pump, and to send air under pressure into the apparatus in order to renew the supply indispensable to life. In the Desgrez and Balthazard arrangement, the apparatus suffices of itself, since it manufactures new air in measure as it is needed, without any auxiliary instrument. The new apparatus consists of three distinct parts, although in reality it forms but one—a prismatic steel box designed to contain the binoxide of sodium and to distribute it according to requirements. To this effect, it is divided into compartments by ten superposed horizontal shelves, each of which carries a supply of binoxide. A clockwork movement causes each shelf to tilt in succession at equal intervals of time. The charge falls into a second cubical box (also of steel), which contains water, and is placed under the preceding box. Finally, a small fan, set in motion by an electric motor, actuated by accumulators, causes a continual circulation of the vitiated air and of the air regenerated in the apparatus and in the close space in which the subject is situated. As the air becomes slightly heated during its regeneration, it is made to pass, upon its exit from the reacting medium, into a refrigeratory that reduces it to its initial temperature. The pieces just mentioned are grouped and inclosed in a hermetically closed aluminium box of circular form.

Finally, the subject isolates the upper part of his body in a hermetic dress with the regenerating apparatus placed in a bag slung upon his back, as shown in Fig. 2.

The entire affair weighs no more than twenty-six pounds, and the volume of air that circulates does not exceed three hundred cubic inches. It is these three hundred cubic inches that are constantly revivified during an hour at least with six ounces of binoxide. Upon increasing the quantity a person might be enabled to live for two, three or more hours.—La Nature.



APPARATUS FOR REGENERATING FOUL AIR.

1. Interior view—Distributing box, electric motor, fan, and water reservoir. 2. General view, showing method of using the apparatus.

TRADE WITH THE SAMOAN ISLANDS.

CONDITIONS in the Samoan Islands since the transfer of Tutuila and Manua to the United States and Savaii and Upolu to the German government is the subject of a report by the British Consul located in the islands, a copy of which has just been received by the Treasury Bureau of Statistics. The report is as follows:

"The islands of Savaii and Upolu were annexed by Germany on March 1, 1900. Shortly afterward, on April 17, the United States took possession of Tutuila and Manua. The only export for many years has been copra, amounting to: In 1897, £45,000; 1898, £60,000; 1899, £90,000; 1900, £46,000. Copra, largely used for the manufacture of soap and candles, etc., goes to the United Kingdom, France, Germany, Russia, Italy and the United States, principally to the United Kingdom and Germany. One of the first acts of the governor was to protect the natives by enforcing fair weights; he is now endeavoring to induce them to make a better article.

"At the present time cacao is engaging much attention here. At a distance of two or three miles from the sea it grows almost wild, and can be cultivated with success everywhere in Samoa, except perhaps on the summit of the mountains, where the climate will probably be too cold. The quality is good. Mr. Carruthers' cacao fetched lately the highest price in the London market. The governor is introducing plants of the celebrated Soconusco variety from Mexico. Cacao planting should draw the attention of home capitalists. The great drawback is that leases from the natives for a longer period than ten years are not likely to be confirmed, as the government does not wish to encourage land speculators, and refers any application of this kind to the Berlin authorities.

"Coffee has been a failure. Even the hardy Liberian coffee introduced a few years ago is now suffering from the same disease that destroyed the Mocha and other varieties. Vanilla and kola promise well. Rubber should also succeed. Bananas and pineapples are shipped occasionally to Auckland in small quantities, but the time occupied in transit is too long, and the fruit is often spoiled on the voyage.

"The principal articles imported are: salt beef in kegs and tinned meats, entirely from Auckland; soap, from Auckland and Sydney; prints, longcloth, and other articles of drapery, etc., principally from Auckland and Sydney, although during the last three years merchants have begun to import from Hamburg many articles formerly brought from the colonies. Kerosene oil, tinned biscuit, and lumber come from San Francisco.

"Commercial travelers from Auckland and Sydney visit Samoa regularly for orders. The large German firm founded by the Godoffroys, for many years established in this group, imports from Hamburg the greatest part of the manufactured goods used in the carrying on of its business.

"At present the import duties are as follows: Ale, 50 cents per dozen quarts; spirits, $2.50 per gallon; wine, $1 per gallon; sparkling wine, $1.50 per gallon; tobacco, 50 cents per pound; cigars, $1 per pound; sporting arms, $4 each; gunpowder, 25 cents per pound. On all other articles, ad valorem, 2 per cent on invoice cost and charges. It is supposed that some alterations will be made before long in this tariff.

"Storekeepers pay a yearly tax of from $12 to $100 per annum, according to the business done. The tax on buildings is 1 per cent yearly on two-thirds of their value; that on trades and professions is from $3 to $60 per annum. There is an export tax of 2½ per cent on the value of copra shipped. All of the above were imposed originally in accordance with the Berlin Treaty of 1889.

"The population of German Samoa consists of about 200 whites, 300 half-castes, and 32,000 natives. Imports, therefore, cannot be very large, native wants in a climate like this being limited; but should planting companies be formed, and the land utilized, matters will assume a very different aspect.

"There is more protection for property now than formerly was the case when the islands were under the rule of a native sovereign. The government is con-

ciliating both parties with much success, and at present the relations between the natives and all foreigners are most amicable. If a rebellion should occur, it would arise out of the disputes between the old conflicting native factions.

"The area of Upolu is 220,000 acres; of Savaii, 410,000 acres; in all, 630,000 acres, of which only 20,000 acres are now being cultivated. One hundred and fifty thousand acres have been sold to foreigners. Commerce would be increased to a very great extent should the land generally be thrown open to improvement by sale or forty-year leases. The price of the land ranges between $2.50 and $25 per acre, according to its situation and improvements. An American company lately sold several thousand acres in blocks at from $2 to $5 per acre.

"There are several schools in Apia, Roman Catholic and Protestant, in which English services are regularly held.

"The area of Tutuila and Manua is small, perhaps 35,000 acres, much of which is steep and mountainous. Tutuila is 70 miles from Apia. Four thousand natives are living on Tutuila, and 1,900 on Manua, and about twenty whites and as many half-castes."

The imports of the Samoan group in 1900 were about £80,000 in value, and the exports £48,000. No details of the 1900 commerce were available when the report was sent, but the 1899 figures showed that the United States held second rank in the countries supplying the imports, the figures being: from British empire, £70,137; from the United States, £18,549; from Germany, £16,290.

CONTEMPORARY ELECTRICAL SCIENCE.*

INFLUENCE OF PRESSURE AND TEMPERATURE ON DIELECTRIC CONSTANTS.—Maxwell's theory, combined with the principle of the conservation of energy, may be employed for finding rules governing the relations between temperature and pressure on the one hand, and the dielectric and magnetic constants of a substance on the other hand. Such investigations serve to impart a physical significance to the rules of Clausius-Mossotti, Lorenz, Beer, and others, which are based upon molecular hypotheses. J. Koenigsberger has arrived at equations differing essentially from those found by Thomson, Drude, Duhem, and others, owing to the fact that he takes into account certain qualities of energy not considered by those authors, and which, he thinks, make a good deal of difference in the case of high dielectric and magnetic constants. The author shows that in solid and liquid bodies the change of a parameter in the electric field has a different effect from that which it would have outside the electric field (or the magnetic field in magnetic substances), and that when such substances are electrified, the phenomena of electrostriction, of Thomson's heating, etc., must be observed.—J. Koenigsberger, Ann. der Physik, No. 5, 1901.

PROPAGATION OF POLYPHASE CURRENTS ALONG PARALLEL WIRES.—W. B. Morton recently gave a method for finding approximately the speed of propagation and the attenuation of electric oscillations guided along certain arrangements of parallel wires. One of the cases worked out was that of an even number of similar wires arranged in a regular polygon, the wires passing through the corners of the polygon at right angles to its plane, and the currents at corresponding points of consecutive wires being opposite in phase. The same author has now extended the problem so as to include the more general case in which there is a constant phase-difference between consecutive wires, as in the ordinary three phase transmission of power. If there are n similar wires the phase difference must be a multiple of $2\pi/n$, and by taking different multiples different *modes* are obtained for each value of n. The number of modes is $\frac{1}{2}n$ if n is even, and $\frac{1}{2}(n-1)$ if n is odd. The analysis leads directly to the distance apart of the "equivalent pair of wires." Further, by comparison with Heaviside's well-known expression for the case of slow oscillations, the author deduces the effective capacity, resistance, and inductance of each of the leads. The second of these quantities comes out in agreement with Lord Rayleigh's formula, as was to be expected.—W. B. Morton, Phil. Mag., May, 1901.

DOUBLE REFRACTION OF ELECTRIC WAVES.—Measurements of the refractive indices for electric waves of different kinds of wood have shown that their double refraction is always accompanied by a double absorption, the wood showing a different absorption of electric waves according to the angle between the grain and the plain of oscillation of the incident waves. G. Pierce, who carried out the experiments referred to, now examines the question as to whether, on Maxwell's theory, the double absorption by these media is sufficient to account for the double refraction, and whether both of these properties can be ascribed merely to differences of conductivity along and across the grain. With the data available a strict interdependence cannot be made out, but it is clear that heterogeneous conductivity plays an important part in the phenomenon of double refraction of electric waves. The absorption coefficient depends upon the direction of the electric force in the specimen. In that orientation of the electric force in which the absorption is greatest, the velocity of propagation is smallest, and therefore the index of refraction is greatest. This agrees with experiment. When the wood is so oriented that its grain is parallel to the electric displacement, the index of refraction is greater than with the grain perpendicular, and so is the absorption.—G. Pierce, Phil. Mag., May, 1901.

DISRUPTIVE DISCHARGE IN ELECTROLYTES.—André Broca and Turchini have found, in experimenting with electric oscillations of a wave-length of some 400 m., corresponding to a frequency of about one million per second, that the properties of the electrolyte placed in the discharge circuit were profoundly modified. Under favorable conditions very powerful disruptive discharges passed through highly conducting liquids, thus showing that for this order of frequency the electrolytes behave as dielectrics. This is a clear experimental explanation of the fact that the electrolytes in question are transparent to light, as they should be according to Maxwell's law. The authors employed a large induction coil fed by a current of 50 amperes at 110 volts, and 42 ∼ per second. The capacity inserted was 12,500 electrostatic units. The sparks produced in acidulated water were extremely brilliant, and the electrodes wore away rapidly. Distilled water shows the phenomenon in great violence, and the sparks remain brilliant when sulphuric acid is gradually added, disappearing, however, when the concentration reaches 1 in 40. In copper sulphate brilliant effects are obtained, even in a 24 per cent solution. The authors believe that at sufficiently high frequencies all transparent electrolytes behave as dielectrics.—Broca and Turchini, Comptes Rendus, April 15, 1901.

OSCILLATING SPARKS.—An ordinary spark has a very irregular shape owing to the irregular distribution of the metallic vapor given off by the electrodes. Besides, the luminous track produced by the initial discharge is strongly marked. G. A. Hemsalech has, however, found that if a variable inductance is inserted in the circuit, then on increasing the inductance the shape of the spark becomes more and more regular, and the initial discharge recedes more and more into the background, so that eventually the discharge appears to consist entirely of incandescent vapor. The shape then taken by the spark is that of a sphere or ellipsoid, with its major axis along the discharge path. Copper and aluminium electrodes give very regular shapes, cadmium and lead irregular ones. In the case of iron, cobalt, zinc, cadmium, copper, aluminium and lead the brightness of the sparks diminishes on increasing the inductance, passes through a minimum, and then rises again. The author gives an interesting demonstration of the effect of introducing an iron core or cylinder in the induction coil. The oscillations are choked off, partly by magnetization, partly by eddy currents.—G. A. Hemsalech, Comptes Rendus, April 15, 1901.

* Compiled by E. E. Fournier d'Albe, in The Electrician.

SELECTED FORMULÆ.

TOOTH POWDERS AND PASTES.

THESE articles, although their direct object is of course to keep the teeth clean and white, also prevent their decay, if it is only by force of mere cleanliness, and in this way and also by removing decomposing particles of food, tend to keep the breath sweet and wholesome. They are, therefore, perhaps, the most important of all toilet articles. The necessary properties of a tooth powder are cleansing power unaccompanied by any abrading or chemical action on the teeth themselves; a certain amount of antiseptic power to enable it to deal with particles of stale food, and a complete absence of any disagreeable taste or smell. These conditions are very easy to realize in practice, and the natural consequence is that there is a very large number of efficient and good powders on the market, as well as not a few which are unfortunately apt to injure the teeth if care is not taken to rinse out the mouth very thoroughly the moment the teeth cleaning operation is at an end. These powders include some of the best cleansers, and have hence been admitted in the following recipes. If due care is taken, as just stated, not to leave any of the powder in the mouth, the risk is very small. The following is a selection from a collection of the best-known recipes for tooth powders and pastes:

1. Charcoal and sugar, equal weights. Mix and flavor with clove oil.

		Ounces.
2.	Charcoal	156
	Red kino	156
	Sugar	6

Flavor with peppermint oil.

3.	Charcoal	270
	Sulphate of quinine	1
	Magnesia	1

Scent to liking.

4.	Charcoal	30
	Cream of tartar	8
	Yellow cinchona bark	4
	Sugar	15

Scent with oil of cloves.

5.	Sugar	120
	Alum	10
	Cream of tartar	20
	Cochineal	3
6.	Cream of tartar	1,000
	Alum	190
	Carbonate of magnesia	375
	Sugar	375
	Cochineal	75
	Essence Ceylon cinnamon	90
	Essence cloves	75
	Essence English peppermint	45
7.	Sugar	200
	Cream of tartar	400
	Magnesia	400
	Starch	400
	Cinnamon	32
	Mace	11
	Sulphate of quinine	16
	Carmine	17

Scent with oil of peppermint and oil of rose.

8.	Bleaching powder	11
	Red coral	12
9.	Red cinchona bark	12
	Magnesia	50
	Cochineal	9
	Alum	6
	Cream of tartar	100
	English peppermint oil	4
	Cinnamon oil	2

Grind the first five ingredients separately, then mix the alum with the cochineal, and then add to it the cream of tartar and the bark. In the meantime the magnesia is mixed with the essential oils, and finally the whole mass is mixed through a very fine silk sieve.

		Ounces.
10.	Whitewood charcoal	250
	Cinchona bark	125
	Sugar	250
	Peppermint oil	12
	Cinnamon oil	8

		Ounces.
11.	Pumice	250
	White coral	250
	Cuttle bone	250
	Cream of tartar	250
	Florence orris root	250
	Sal-ammoniac	60
	Ambergris	4
	Cinnamon	4
	Coriander	4
	Cloves	4
	Rose-wood	4
12.	Dragon's blood	250
	Cream of tartar	30
	Florence orris root	30
	Cinnamon	16
	Cloves	8
13.	Red coral	250
	Cuttle bone	250
	Dragon's blood	250
	Red sandalwood	125
	Alum	125
	Orris root	250
	Cloves	15
	Cinnamon	15
	Vanilla	8
	Rosewood	15
	Carmine lake	250
	Carmine	8

This tooth powder is said to be a favorite in America.

14.	Cream of tartar	150
	Alum	25
	Cochineal	12
	Cloves	25
	Cinnamon	25
	Rosewood	6

Scent with essence of rose.

15.	Coral	20
	Sugar	20
	Wood charcoal	6
	Essence of vervain	1
16.	Precipitated chalk	500
	Orris root	500
	Carmine	1
	Sugar	1
	Essence of rose	4
	Essence of neroli	4
17.	Cinchona bark	50
	Chalk	100
	Myrrh	50
	Orris root	100
	Cinnamon	50
	Carbonate of ammonia	100
	Oil of cloves	2
18.	Gum arabic	30
	Cutch	80
	Licorice juice	550
	Cascarilla	20
	Mastic	20
	Orris root	20
	Oil of cloves	5
	Oil of peppermint	15
	Extract of amber	5
	Extract of musk	5
19.	Chalk	200
	Cuttle bone	100
	Orris root	100
	Bergamot oil	2
	Lemon oil	4
	Neroli oil	1
	Portugal oil	2
20.	Borax	50
	Chalk	100
	Myrrh	25
	Orris root	22
	Cinnamon	25
21.	Wood charcoal	30
	White honey	30
	Vanilla sugar	30
	Cinchona bark	16

Flavor with oil of peppermint.

22.	Sirup of 33° B.	38
	Cuttle bone	200
	Carmine lake	30
	English oil of peppermint	5
23.	Red coral	50
	Cinnamon	12
	Cochineal	6
	Alum	2½
	Honey	125
	Water	6

Triturate the cochineal and the alum with the water. Then, after allowing them to stand for 24 hours, put in the honey, the coral and the cinnamon. When all the effervescence has ceased, which happens in about 48 hours, flavor with essential oils to taste.

		Ounces.
24.	Well-skimmed honey	50
	Sirup of peppermint	50
	Orris root	12
	Sal-ammoniac	12
	Cream of tartar	12
	Tincture of cinnamon	3
	Tincture of cloves	3
	Tincture of vanilla	3
	Oil of cloves	1
25.	Cream of tartar	120
	Pumice	120
	Alum	30
	Cochineal	30
	Bergamot oil	3
	Clove	3

Make to a thick paste with honey or sugar.

26.	Honey	250
	Precipitated chalk	250
	Orris root	250
	Tincture of opium	7
	Tincture of myrrh	7
	Oil of rose	2
	Oil of cloves	2
	Oil of nutmeg	2

—Oils, Colours and Drysalteries.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Ports of the Argentine Republic.—The increase in the productive power of the Argentine Republic has caused the steady development of the various outlets to the countries beyond the sea.

The city of Buenos Ayres, the capital of the Republic, has been for many years the point to which gravitated all that was of value from the interior provinces; but with the growth of production, it has been found best to forward the goods to the nearest port.

The city of Rosario receives yearly an immense amount of grain from the interior. An enlargement of the present port is demanded. Higher up the Parana River is the port of Colastine; but as it is subject to inundations, its usefulness will probably be confined to the shipment of hardwood lumber, sleepers, and quebracho stock for the manufacture of tanning fluid.

San Nicolas, situated on the boundary of the two provinces of Buenos Ayres and Santa Fe, is a port which has never done a great deal of shipping except in connection with the river traffic. The various railways which connect it with Buenos Ayres facilitate shipments to this more important market. Buenos Ayres has an excellent system of docks, but a serious drawback is the want of water in the channels which connect them with the ocean. The channels must be constantly dredged, or the entrance to the docks would not be practicable except for steamers of comparatively light draft. The largest steamers which visit the River Plata are debarred from making use of the port of Buenos Ayres, except in certain conditions of the river. These call at La Plata (formerly called Ensenada), which is connected with Buenos Ayres by rail. Here again, constant dredging must be done; but when cattle shipments are resumed, this port will be largely made use of, on account of its proximity to the establishments whence the cattle are sent. The next port southward is Bahia Blanca, which, as it is the terminus of the Great Southern Railway, bids fair to develop in future.—D. Mayer, Consul at Buenos Ayres.

Gas Water Heater in France.—I have had an opportunity to examine a new gas water-heating machine, which it is claimed furnishes hot water to a number of rooms, and the gas in which can be lighted or extinguished at any distance from the heater. The apparatus may be placed in any part of the house. In the case of buildings furnished with water by a reservoir in the garret or mansard, the only requisite is that the apparatus shall be placed not less than 5 feet below the reservoir. A second contrivance closes that portion of the mechanism used to provide hot water, so that the supply may be received cold, as desired. The apparatus contains a device whereby gas not consumed is prevented from accumulating in the apparatus, and explosions are obviated.

In the experiment witnessed by me, one faucet was placed immediately at the apparatus and another some 50 feet away. The diminutive gas jet was lighted and turned into the apparatus, and the water feed-pipe faucet turned. Upon opening the discharge faucet, the gas was instantly lighted, and ten seconds later about 12 quarts of water at 35 degrees C. was issuing from the faucet per minute. On opening the faucet half way, the supply came cold; on opening it a little more, hot water came; and on closing it, the gas was instantly extinguished.

The inventor asks from $60 to $70 each for the apparatus.—Harold S. Van Buren, Consul at Nice.

Drawbacks to American Bicycle Trade in England.—Two or three years ago, the American bicycle trade was in a flourishing condition in England and Wales, our wheels being greatly admired on account of their good workmanship and lightness. Gradually, however, complaints were heard, and at last the bicycles fell into bad repute, and the import trade in this line from the United States has lost considerable ground.

I have for some time been making inquiries into the causes of this and submit the following, which I hope American bicycle manufacturers will read, for there is no reason why our machines should not once more come to the front. Our manufacturers must not overlook the fact that English climate and roads are totally different from ours, and should make alterations in cycles for the English trade, as follows:

First. Handle bars should have seven-eighths inch stems; width, about 15 inches.

Second. Brake work should be better fitted. Rim brakes are now used on almost all machines. It is claimed here that a good set of brake work has not been seen on an American machine.

Third. Cranks should be of the square pattern, keyed on both sides of axle; axle to be five-eighths of an inch in diameter at ends. Cranks should be 7 inches long, with holes tapped, with right and left hand threads, in ends for pedals; pedal spindles 9, 16 and 20 threads. The crank shaft should be of one piece; not forged in two pieces connected by a screw. Owing to the hard, stony, and, for the most part, rough-surfaced English roads, this screw becomes loosened and gives constant trouble to the English rider, while the one-piece crank is supposed to give firmness and strength to the whole machine.

Fourth. Saddle pillar tops should be seven-eighths of an inch in diameter, so as to take the standard English saddles. For some reason, English riders do not like American saddles.

Fifth. Rims should be of steel. Wooden rims, owing to the damp atmosphere and long-continued rains in this country, are liable to warp and the spokes to become loosened, resulting in total disintegration of the wheels. There is reason to believe that this could to a great extent be averted, were our manufacturers to select thoroughly seasoned lumber for the manufacture of rims for exportation.

Sixth. The tires (double tubes) should always be wired on or hooked on.

The foregoing information I have gleaned from numerous bicycle firms and from private parties who have owned American cycles.

Lately, several American firms have requested addresses of the most prominent cycle firms in Swansea. The Dan Morgan, Limited, bicycle agents and manufacturers, and the Cambrian Cycle Company are among the most important.—Griffith W. Prees, Consul at Swansea.

Draining the Zuider Zee.—Consul Hill writes from Amsterdam, May 14, 1901:

A measure has been proposed in the States General of the Netherlands to close the Zuider Zee by a dike running from the North Holland coast to the island of Wieringen and thence to the Frisian coast, and to drain parts of the closed sea. The plan involves the recovery in eighteen years of 46,500 hectares (114,-901½ acres) of fertile land. The railway distance between the provinces of North Holland and Friesland will be shortened by 31 miles. The indemnity to be paid to the Zuider Zee fishermen is estimated at 4,500,000 florins ($1,809,000). The total cost is estimated at 95,000,000 florins ($38,190,000). It is intended to call this twelfth province of the Netherlands Wilhelminaland.

The following additional details are supplied by Consul-General Guenther, of Frankfort, under date of May 8, 1901:

The large bay formed by the North Sea in the coast of Holland, called Zuider Zee, has for centuries been of more harm than profit to the people. Navigation is hardly possible, and it frequently suffers from floods, the shores being converted into swamps. The southern part will be drained by the erection of a levee about 19 miles long and 6½ feet wide, constructed in an average depth of water of between 11 and 12 feet.

The levee will be about 18 feet higher than the level of Amsterdam, and will be capable of resisting the force of the waters even during the most violent storms.

Four other levees will be built in order to make four large inclosures, which will afterward be freed from water.

It is estimated that it will take from thirty to thirty-five years to complete the work, and some 500,-000 acres of soil will be reclaimed, valued at $160,-000,000. The damage which has periodically been done to the shores of the Zuider Zee will also be obviated. At the breaking of the levee in 1885, 371 lives were lost, and a damage of 14,000,000 florins ($5,628,000) was caused to buildings and agricultural products.

Industrial Conditions in Roumania and Servia.—The European press has been calling attention to the recent industrial activity of the Balkan Peninsula, and particularly to the efforts which the kingdoms of Roumania and Servia are making to induce capitalists to establish manufactories of various kinds in these countries. The governments of these countries are holding out substantial inducements to parties who will start industrial enterprises.

An English firm, under agreement to start a cotton-spinning and weaving factory, has been granted the following concessions by the Roumanian government: Exemption from all direct state, provincial, and local taxation; the right to import free of duty all materials to be used in the erection of the factory, as well as all the raw stuff for the manufacture of cotton goods.

In Servia, a German syndicate has been granted a concession to erect a celluloid factory in the city of Raschka, on the Turkish frontier, and operate it for twenty years. The syndicate is under obligation to invest at least 3,000,000 francs ($579,000) in the enterprise, but is then exempt from all taxation and has the right to import raw stuffs for the factory free of duty. This syndicate is likewise granted the right to erect steam sawmills and to cut timber on the crown lands, with the restriction, however, that only trees measuring at least 30 centimeters (11.8 inches) in diameter must be cut down, and that none of the lumber sawed must be sold in Servian territory.

The government is very anxious to see one or more paper mills started in the country. Timber from which wood pulp can be produced is said to be plentiful in Servia, and all other raw stuffs necessary for the manufacture of paper can be imported free of duty.

Manufactures of other descriptions are also said to be needed, and, on the whole, it might be worth while for enterprising Americans to look up the industrial and commercial situation on the Balkan Peninsula.—S. Listoe, Consul at Rotterdam.

Credit of Roumanian Business Houses.—Consul Monaghan, of Chemnitz, May 18, 1901, informs the Department that the Royal Roumanian Ministry has recently issued the following statement:

As it often happens that business men desiring information as to the credit, etc., of Roumanian business houses apply to persons who are not in a position to give correct data of this kind, the ministry has given orders to the ten Roumanian chambers of commerce to furnish to foreign as well as inland inquirers the most conscientious and exhaustive information as to the credit and business importance of Roumanian firms. This is to be given free of charge, and either in the German or French language. The Royal Roumanian Ministry wishes persons interested to take note of the above instructions, and to seek information only from the chambers of commerce. Inquiries should be sent to the chamber of commerce nearest the place of business of the firm concerning which information is sought. The ten Roumanian chambers of commerce are Bucharest, Braila, Botosani, Craiova, Kustenji, Focsani, Galatz, Jassy, Pitesci, and Ploesci.

Well-Boring Machinery and Windmills in Yucatan.—It is reported that Lic. Pablo Martinez del Rio, of Mexico City, has been granted a concession by the Mexican government to develop the oil springs in the States of Tamaulipas, San Luis Potosi, and Vera Cruz. According to the terms of the concession, the work must be commenced within six months, and at least twenty wells shall be drilled during the first year. The capital of the company is $600,000 Mexican currency. I would suggest as the best method of securing orders for the machinery required for this enterprise that our manufacturers at once send an agent to Mexico City to see Mr. Martinez and furnish him with drawings, estimates, and all particulars as to prices, etc.

I have also been investigating the need of well-boring machinery in the State of Yucatan. Probably owing to its geographical position, this state has been generally overlooked by manufacturers, and as a result one of the best fields in this line in the Republic of Mexico is almost wholly undeveloped. I have talked with several persons who have traveled over Yucatan, and I am informed that there is not a well-boring machine in the state, with the exception of a large deep-boring outfit at Merida, the capital. The entire water supply comes from shallow wells, generally from 25 to 100 feet deep, but limestone has to be blasted out from the very surface. It is my belief that if our manufacturers of light well-boring machinery, which can be run by horse power, such as is used extensively in the United States, would send a practical man to Merida, set up a machine there, and bore a few wells, a large number of orders could be secured.

Yucatan is also an ideal country for windmills; the entire peninsula is flat, a steady breeze blows most of the time, and a windmill would never have to contend with storms, such as occur in many parts of the United States. All the water here comes from the ground, and, as the high price of fuel precludes the use of steam pumps, recourse must be had to windmills, or, as at present, to horse power.—Wm. W. Canada, Consul at Vera Cruz.

Oriental Carpet Trade.—Consul Hughes reports from Coburg, May 24, 1901:

The preference shown by Europeans and Americans for Oriental carpets increases each year. For three or four years, the prices have risen 25 to 30 per cent, and for certain kinds, even 50 to 60 per cent. The rise is not due so much to the increasing demand as to the fact that the old carpets are becoming more scarce, and, as those of modern manufacture are very imperfect, they will not be replaced by new ones equally as good. Of the modern carpets, only the large ones from Asia Minor (Smyrna), the Persian (particularly the Kirmans), some from Afghanistan, and the small but carefully worked Merws are very much sought. The small ones from Caucasia and Central Asia do not meet with particular favor. The time is not far distant when the old carpets will be all bought up, and it would be advisable for some wealthy collector to obtain samples of the still existing old carpets and place them in one of our well-known museums.

Carriages in the Netherlands.—Consul Hill writes from Amsterdam, May 31, 1901:

There is but one firm at Amsterdam dealing in American carriages at present, and even this one will probably give up the business soon, as the article does not sell well here. The reasons given are that American carriages are so constructed that they can scarcely turn in the narrow Amsterdam streets, and are not strong enough to be used on Dutch roads. It is also claimed that American wood is unable to stand the wet climate, and cannot be readily procured here—hence repairs cause much trouble. Carriages are also too cheap to be trusted by Dutch buyers, prices ranging here from 450 to 2,800 florins ($180 to $1,120). Some are sold to the Dutch East Indies, but the demand is not regular. American manufacturers, in order to secure a place in this market, should copy Dutch models. The duty is 5 per cent ad valorem.

American Products Abroad.—Consul Marshal Halstead writes from Birmingham, May 29, 1901:

American manufacturers and merchants frequently open correspondence with United States Consuls with the sentence: "Being desirous of taking advantage of the rapidly growing demand for American products, etc." There is for American goods no foreign demand of the shake-the-tree kind these inquiries have in mind. The sales of our goods of all kinds are based on the merits and low prices of the articles, after energetic salesmen have made active demonstration of good points. I cannot understand the mental attitude of those American manufacturers who employ traveling salesmen to get trade in America, paying good salaries and allowing liberal sums for traveling expenses, yet wish to do business by correspondence in foreign countries. Why do they imagine they can trade successfully in Great Britain, Germany, or any other European country without employing their own travelers, when the necessity of having them is the first principle of their home business?

Preserving Fresh Fruit in Victoria.—The following, dated Frankfort, June 5, 1901, has been received from Consul-General Guenther:

The German consul-general at Sydney reports that the agricultural department of Victoria has recently made experiments with reference to the preservation of fresh fruits. Pears and peaches packed in the ordinary boxes for shipment were subjected to the vapors of hydrocyanic gas. The fruits were then taken out of the boxes and separately wrapped in tissue paper. Some of them were again treated with the gas, and the whole lot was placed in a dry room at a temperature of 40 deg. F. and kept there for seven weeks. When the fruits were taken out, they were in an excellent state of preservation, especially those that had been treated with the gas a second time. Not only the pears, but the peaches all felt hard to the touch, retained their fresh appearance, and showed no decayed spots, as the germs had all been killed by the gas.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECIPES.

Polish for Show Windows.—Mix calcined magnesia with purified benzine to a semi-liquid paste. Rub the panes with this, using a cotton wad, until they are bright.—Der Deutsche Kaufmann.

Ink for Writing on Celluloid.—Powdered tannin 15 grammes, dry ferric chloride 10 grammes, acetone 100 grammes. Dissolve the tannin and the ferric chloride separately, each in one-half of the acetone, whereupon the two solutions are mixed together.—Praktischer Wegweiser.

To Attach Copper to Glass.—Boil 1 part of caustic soda and 3 parts of colophony in 5 parts of water and mix with the like quantity of plaster of Paris. This cement is not attacked by water, heat and petroleum. If in place of plaster of Paris, zinc white, white lead or slaked lime is used, the cement hardens more slowly.—Die Werkstatt.

Preparation of Artificial Mineral Salts.—In our issue of July 13, 1901, page 21358, we gave formulas for making artificial mineral salts in which *chlorates* of potassium and sodium are called for, while potassium and sodium *chloride* are really meant. Subscribers are requested to change the termination "ate" to "ide" in their papers, as the formula made up as originally published would be poisonous.

Waterproof Glue.—Soak 1 kilo. of Cologne glue in cold water for 12 hours and in another vessel for the same length of time 150 grammes of isinglass in a mixture of lamp spirit and water. Then dissolve both masses together on the water bath in a suitable vessel, thinning, if necessary, with some hot water. Next add 100 grammes of linseed oil varnish and filter hot through linen.—Deutsche Mechaniker Zeitung.

Acid-Proof Putty.—Melt 1 part of gum elastic with 2 parts of linseed oil and mix with the necessary quantity of white bole by continued kneading to the desired consistency. Hydrochloric acid and nitric acid do not attack this putty, it softens somewhat in the warm and does not dry readily on the surface. The drying and hardening is effected by an admixture of ½ part of litharge or red lead.—Pharmaceutische Rundschau.

Cleaning and Polishing Linoleum.—Wash the linoleum with a mixture of equal parts of milk and water, wipe dry, and rub in the following mixture by means of a cloth rag: Yellow wax 5 parts, turpentine oil 11 parts, varnish 5 parts. As a glazing agent, a solution of a little yellow wax in turpentine oil is also recommended. Other polishing agents are: 1. Palm oil 1 part, paraffin 18, kerosene 4. 2. Yellow wax 1, carnauba wax 2, turpentine oil 10, benzine 5.—Apotheker Zeitung.

Triumph of the X-Rays at Buenos Ayres Custom House.—The smuggling of jewelry recently discovered at the main post office of Buenos Ayres has afforded an excellent test of the Roentgen rays. The practice consisted in the jewelers and goldsmiths receiving jewelry of great value in registered letters from Europe, thus cheating the custom house. The latter was in a sore predicament, since the opening of suspicious money letters, officially, is not admissible. Recently an attempt was made by the post office department, in the presence of the Minister of the Interior, the Custom House Collector and many other high officials, to examine registered packages as to their contents by the aid of the X-rays without violating the law, and the experiment has given the most satisfactory results. Among 66 registered pieces from Berlin, Paris, Berne, etc., the X-ray apparatus revealed in 13 packages twelve little ladies' watches each; in 17 packages, one-half dozen of men's watches each; in 14, cardboards with rings sewed on; in 4, a whole conglomerate of chains, earrings, pins, etc., none of which had been declared, of course. After the smuggle had been proved in this manner satisfactory to the law, the Federal judge ordered the official opening of the packages in question, the value of the confiscated articles, according to a superficial estimate, amounting to more than $20,000 in gold. When it is considered that the packages seized arrived at Buenos Ayres all within a period of only one week, the total amount of the customs defraudations may be easily imagined, since it is known for a certainty that similar smugglings have been going on for a long time past. The respective addressees are said to have ordered these articles to be sent as indicated at their own risk, so that they alone have to bear the loss.—Deutsche Goldschmiede Zeitung.

Varnish for Beach Shoes.—The Seifensieder Zeitung recommends the following recipes:

YELLOW.	
Water	150.000 kilos.
Borax, crystallized	5.000 "
Glycerin, technical	2.500 "
Spirit of salammoniac technical	0.250 "
White shellac	25.000 "
Yellow pigment (No. 690), water-soluble	0.800 "
Formalin	0.125 "
ORANGE.	
Water	150.000 kilos.
Borax, crystallized	5.000 "
Glycerin, technical	2.500 "
Spirit of salammoniac, technical	0.250 "
Ruby shellac	22.500 "
Orange R, water-soluble	0.800 "
Brown, No. 2923	0.300 "
Formalin	0.125 "
PALE BROWN.	
Water	150.000 kilos.
Borax, crystallized	5.000 "
Glycerin, technical	2.000 "
Spirit of salammoniac, technical	0.250 "
White shellac	25.000 "
Yellow, No. 690, water-soluble	8.000 "
Orange R	0.300 "
Formalin	0.125 "

Stir the glycerin and the spirit of salammoniac together in a special vessel before putting both into the kettle. It is also advisable, before the water is boiling, to pour a little of the nearly boiling water into a clean vessel and to dissolve the colors therein with good stirring, adding this solution to the kettle after the shellac has been dissolved.

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